

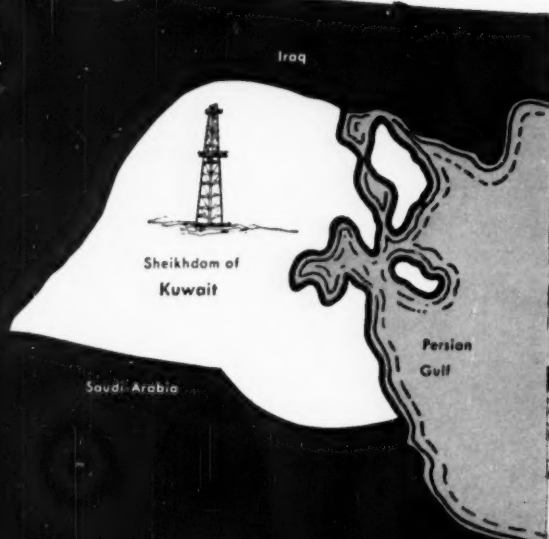
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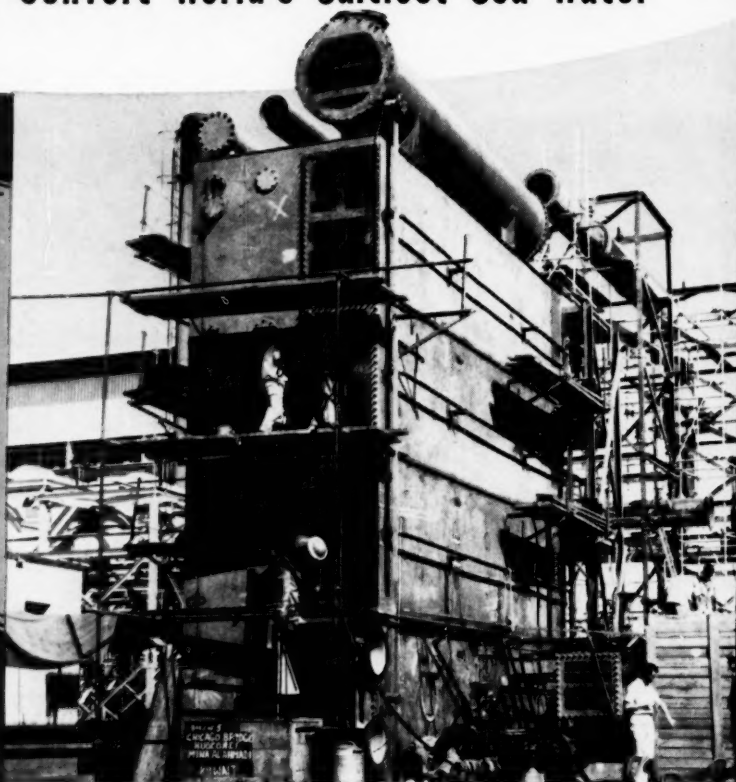




—built Evaporators Convert World's Saltiest Sea Water



Persian Gulf Sheikhdom Quenches Centuries of Thirst



At the tip of the Persian Gulf, between Iraq and Saudi Arabia lies the Sheikhdom of Kuwait, blessed with seven percent of the world's oil and, until recently, plagued with some of the world's most *brackish* drinking water.

Once thirsty Kuwait has now solved its age-old problem. A CB&I-built "flash" evaporation system, designed by Westinghouse, now helps to convert Persian Gulf water—the world's saltiest, with 42,000 parts of dissolved solids per million gallons—into a fresh, potable liquid containing less than 100 parts dissolved solids per million gallons.

The overall system handles 5,000,000 gallons of fresh water daily for the capital city. Conversion is made at a rate of more than three pounds of drinking water for *each pound* of steam consumed.

An unusual installation? Yes, but typical of the world-wide background of experience with which CB&I steel plate specialists can meet the *most specific* customer requirements. This same *craftsmanship in steel* is available to you.

Write your nearest CB&I office for further details on the Kuwait Story and for the brochure: *CB&I Special Plate Structures*.



Above right

● One of two 4-stage flash evaporators built by CB&I and erected by Chicago Bridge Limited, London for Westinghouse International Corporation. "Flash" system replaces "shell and tube" unit—occupies 25 percent less space, handles double the capacity of fresh water.

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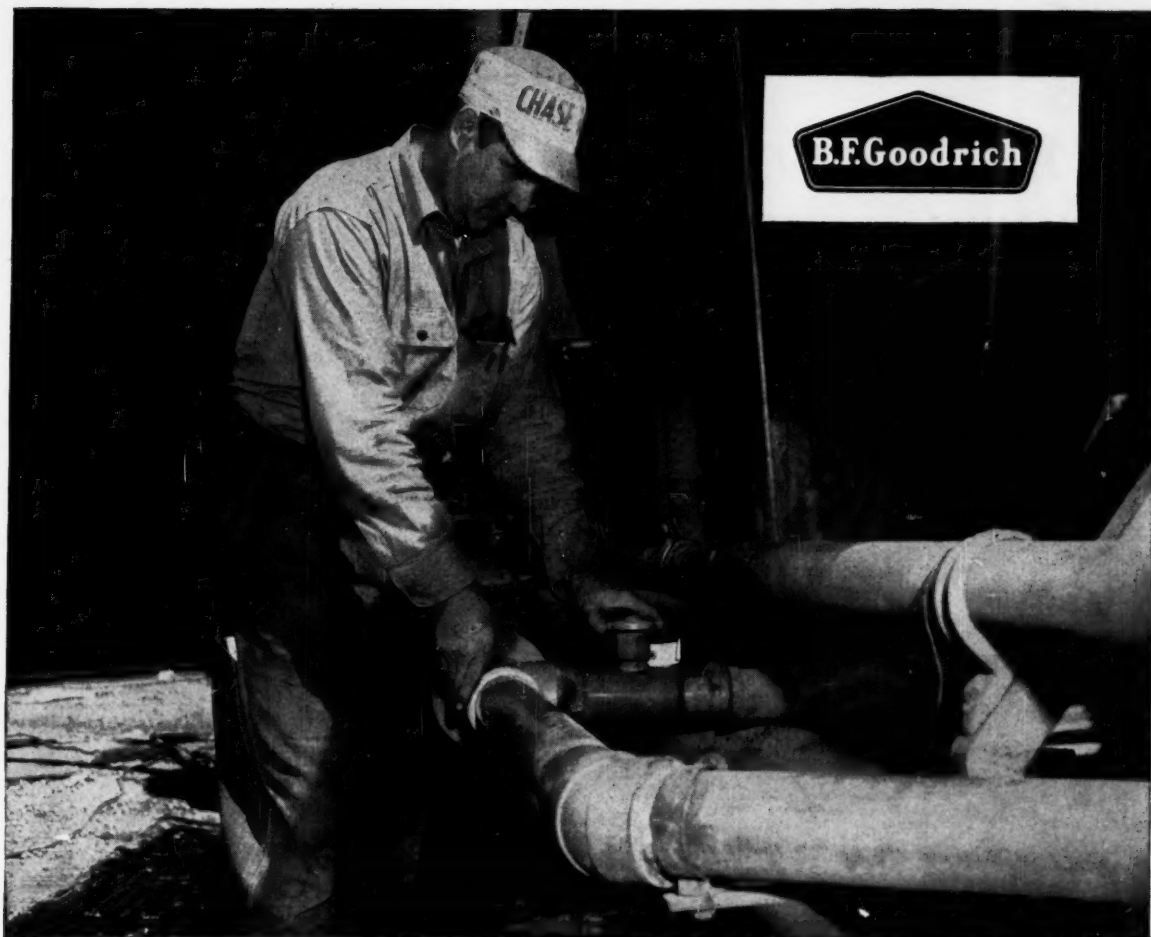
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liquid feed destroys steel pipes... can't hurt B.F. Goodrich Koroseal

SIXTEEN hours a day, five days a week, a corrosive liquid pours through a pipe in the Riverdale, Illinois plant of Hales & Hunter Company. For years this producer of animal and livestock feed ran this fluid through stainless steel and black pipes.

Corrosion was caused from a mild acid solution which necessitated the changing of piping after approximately 12 months of service. Then in June, 1956 the company installed B. F. Goodrich High Impact Koroseal Pipe. Since then 30 gallons a minute, equal to 154 tons per 16-hour day, have been pouring continuously through this two-

inch Koroseal pipe. There have been no maintenance problems and no sign of leakage or wear.

Rigid Koroseal polyvinyl chloride pipe is a relatively new development that is gaining wider usage month in and month out. The pipe is made of Koroseal by a process which permits extrusion and molding of compounds for complete rigidity and high impact quality. B. F. Goodrich Koroseal rigid PVC not only has the highest impact resistance of any thermoplastic pipe, but won't corrode, is easy to install, and cuts maintenance.

To find out how Koroseal can make

your operations more efficient, fill in and mail the coupon below. *B. F. Goodrich Industrial Products Company, Marietta, Ohio.*

**B. F. Goodrich Industrial Products Co.
Dept. CE-2
Marietta, Ohio**

Please send me booklets on:

- ☐ Rigid Koroseal Pipe
☐ Rigid Koroseal Sheet

Name

Company

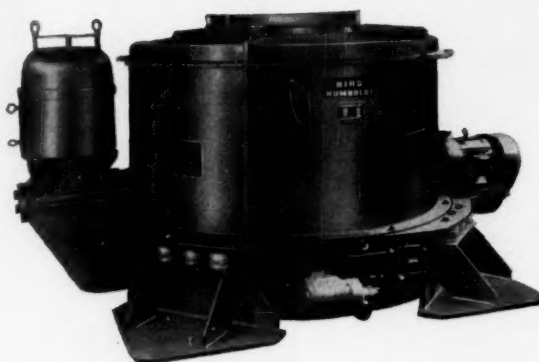
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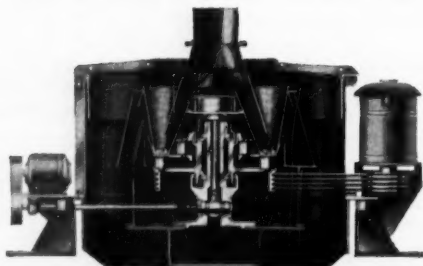
the
BIRD-HUMBOLDT
 Oscillating Screen Centrifuge

The Bird-Humboldt Centrifuge has already demonstrated its value to the coal and potash industries.

Its operating advantages and economies are such as to justify immediate consideration whenever you have a feed slurry in the plus 65 mesh range. They include:

big capacity — sizes from 5 to 50 tons per hour or more
thorough dewatering — solids discharge on the order of 5% or less surface moisture
high solids recovery — 98 to 99% of solids input

almost no degradation of solids
long screen life — up to 3000 hours or more
low power input — on the order of 0.2 KWH per ton of dried solids



The Bird-Humboldt provides a unique combination of centrifugal and oscillating force, resulting in a smooth continuous fluid of flow of solids across the screen. The result is an evenly distributed, porous layer of solids in which the particles are constantly shifting their position, permitting the moisture to escape. Virtually no fines get into the effluent. Action is gentle and there is no scraping. This accounts for the amazing lack of screen wear and of solids degradation. *Write for descriptive Bulletin. Recommendations and estimates can be based on test data from the Bird Research and Development Center.*

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- Bird-Young Single Cell Rotary Vacuum Filters
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- Bird-Humboldt Screen Type Oscillating Centrifuges
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Chemical Engineering

FEBRUARY 9, 1959

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except the 1st



THIRD OF TWENTY-SIX 1959 ISSUES

3/26

Right way to buy sieves and screens

Savvy engineers specify screen opening sizes whenever they order sieves. They know that the common practice of ordering by mesh just won't do; there are too many standards. For maximum throughput and desired particle size, it's the size of the hole that counts. Here's your guide to proper screen selection—for speedier and more economical screening operations. (p. 107)



Time-saving tips on leaching

Here's a way to figure solid-liquid extraction requirements when ideal assumptions can't be made. It uses four steps—one graphical—to cut down on pilot-plant work when you're solving non-equilibrium leaching problems. (p. 111)



Where the silicon rectifier stands today

Newest kind of power rectifier is the semiconductor. Most important of these a.c.-d.c. converters is the silicon rectifier. So here's a rundown of its pros & cons—background and facts for potential electrochemical users faced with new decisions to make and unfamiliar factors to evaluate. (p. 119)



How to be a smarter engineer

Good engineers—and there are lots of them—design processes that work successfully. The real payoff comes to those who engineer for a profit. Here's a tipoff for you on the better ways to look at your problems. (p. 134)



BALL BEARING HANGER has self-aligning bearing and seal—adjusts to suit shaft deflection. Square tube member of frame is positioned to permit easy passage of materials.



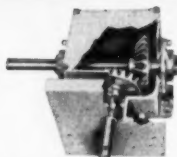
QUIK-LINK CONVEYOR SCREW. For ease in removal of conveyor section without dismantling other components. Feature can be furnished on Helicoid and Sectional Flight Conveyors.



TROUGH END SEAL assembled between flange block and trough end plate, keeps grease in, dirt out. Used with lip, felt or waste packing seal to prevent bearing-product contact.



DOUBLE BALL BEARING Flange Block employs two Link-Belt precision ball bearings spaced to withstand overhung load at drive end and take thrust loads of screw in either direction.



BALL AND ROLLER BEARING COUNTERSHAFT END. For drives at right angles to screw conveyor or common drive for two conveyors intersecting at right angles—absorbs thrust.

Complete line of accessories can be installed on new or existing systems

THOUGH just recently introduced, these Link-Belt screw conveyor components have already achieved a wide acceptance. Throughout industry, they're cutting power and maintenance demands to a new low.

Design refinements include the Quik-Link conveyor screw that makes removal of conveyor section possible without dismantling other components. Starting and running friction is reduced through the use of Link-Belt ball bearing hangers, as well as new ball bearing trough ends. Trough ends can be furnished with seals to protect bearings—seals are rabbetted for perfect bearing alignment.

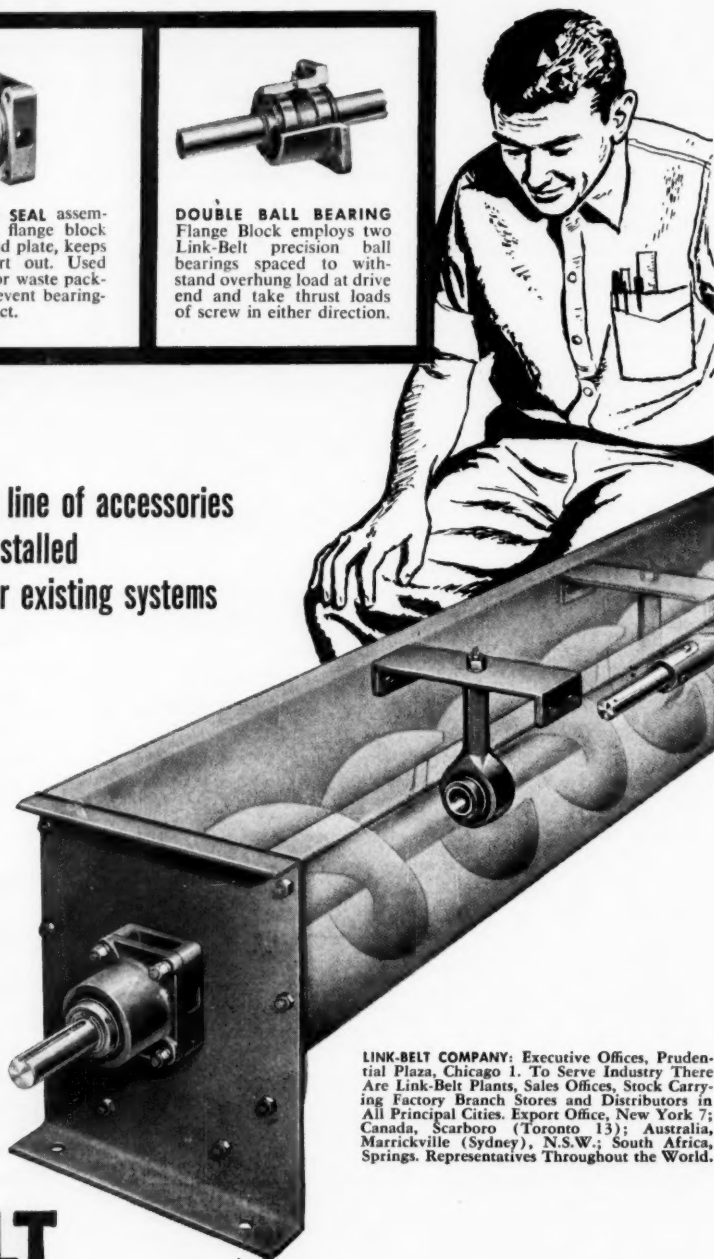
For facts, call your nearby Link-Belt office or authorized stock-carrying distributor. Or write for Folder 2489.

LINK-BELT



SCREW CONVEYORS

14,782



LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

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FEBRUARY 9, 1959

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Developments in Chemical Engineering

CHEMENTATOR

- Methanol Muddle: Who's Responsible?..... 55
- Pressure Slashes Electrolysis Power..... 57
- Competing Processes Join Hands..... 57
- New Nuclear Grades of Graphite..... 60
- Shifting Patterns in Energy Supply..... 60
- Delayed Coking Skirts Sulfur Rule..... 62
- Keep Close Tabs on Water Quality..... 62
- Vortex Tube Aims at Cool Markets..... 62

PROCESSES & TECHNOLOGY

- New Concept Changes Control Outlook..... 64
- First Nonaqueous Recovery of Fuel..... 68
- Bell Opens Door to Man-Made Quartz..... 72

CHEMICAL ECONOMICS

- Chemicals Team Up for Better Polish..... 76

CHEMICAL PRODUCTS

- Newsworthy Chemicals and Raw Materials.... 82

PROCESS EQUIPMENT

- Drying Problem? Try New Heater..... 88
- Equipment Cost Index..... 170

PROCESS FLOWSHEET

- Chemical Engineering Updates Dough-Making 98

Practice of Chemical Engineering

FEATURE ARTICLES

- * Include Screen Opening Size..... 107
Stanley Goldberg, Warren Walter
- Calculate Stages Graphically..... 111
Wendell J. George
- Heat Transfer and Pressure Drop..... 115
Ning Hsing Chen
- Silicon Power Rectifiers Take Over..... 119
G. E. Shields, R. P. Stratford, H. H. Zielinski
- How P&T Change Liquid Viscosity..... 123
Wallace R. Gambill

CE COST FILE

- Piping Insulation Costs..... 128
Max Bass

PROCESS DESIGN NOTEBOOK

- Unconventional Vessel Heads Save Cost..... 130
J. Klengen
- Control Vacuum Evaporation by Temperature 132
Paul W. Kilpatrick

YOU & YOUR JOB

- You Can Be a Smarter Chemical Engineer.... 134
Charles E. Carroll

OPERATION & MAINTENANCE

- Is This a Better Tool for You?..... 140

CORROSION FORUM

- New Urethane Coatings Tops in Resistance... 144

Other Regular Features

- Firms in the News..... 151
- Convention Calendar 160
- More New Equipment Developments..... 162
- Technical Bookshelf 172
- Letters: Pro & Con..... 176
- Classified Section 199
- Equipment Searchlight 200

Reader Service

- Guide to Technical Literature 182
- Reader Service Postcard 185
- Reprints Now Available 187
- Advertisers in This Issue..... 206



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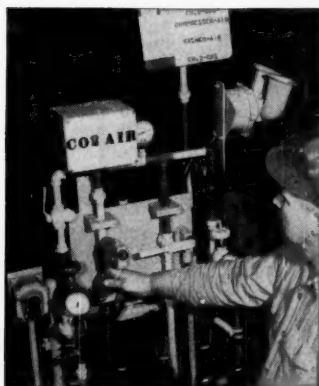
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JOY OIL-FREE COMPRESSORS HELP GUARD QUALITY OF NATIONAL BOHEMIAN BEER



Oil-free compressed air is used for other operations in the "National-Bob" plant.

The National Brewing Company, Baltimore, Md., uses oil-free compressed air to regulate an important phase of their processing. Temperature control during pasteurizing is a critical point in the brewing of fine beer. Recording instruments control the steam inlet on preheat and precool tanks. The compressed air that operates these instruments must be free of oil and water or they plug up and record incorrectly.

National Brewing hasn't had a bit of trouble with this operation since they installed their first Joy Oil-Free Compressor. These compressors use carbon piston rings that require no lubrication. No oil in the cylinder—no oil in the compressed air.

Is National Brewing happy? They placed a second Joy unit in operation a year later. Find out more about Joy oil-free compressors . . . write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: **Joy Manufacturing Company, (Canada) Limited, Galt, Ontario.**

JOY

...EQUIPMENT FOR INDUSTRIAL PLANTS... FOR ALL INDUSTRY



NEED OIL-FREE AIR...
WRITE FOR FREE
BULLETIN 167-11.

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COMPRESSORS



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FANS AND
BLOWERS

Which
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these
5
products
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you
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Solve Dye Problems with BECCO Silicate-Free Bleaching



"We dyed half a million yards
this week...with no rejects!"

So reports a new user of Becco Silicate-Free Bleaching Process,* who previously suffered up to 25% rejects.

When complex silicates of calcium and magnesium formed scale on equipment and left resistant residues in the cloth, a Becco Sales Engineer studied the situation, and recommended Silicate-Free Hydrogen Peroxide bleaching solutions which eliminated the problem.

Silicate-Free bleaching won't answer every textile bleaching problem. But chances are one Becco process or another will. If you need help, use the coupon below to request a Sales Engineer's call. Also, ask for your free copy of Bulletin No. 71, "Continuous Bleaching of Cottons with Silicate-Free Peroxide Solutions".

*U.S. Patents 2,740,689 and 2,820,690

Problems in handling Hydrogen Peroxide

?

Becco's Four-Fold Engineering Service Program—offered free—includes:

1. Comprehensive survey of your facilities.
2. Specific proposal with recommendation of proved equipment and where it is obtainable.
3. Installation supervision by Becco.
4. Periodic inspection and permanent service.

Can you use this free Becco help, based on more years of experience with bulk handling of H_2O_2 than any other manufacturer? Use the coupon to let us know.

BECCO



FOOD MACHINERY AND
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Becco Chemical Division
STATION B, BUFFALO, NEW YORK

BECCO



BECCO CHEMICAL DIVISION, FMC
Station B, Buffalo, New York
Dept. CE-A

Gentlemen:

- ☐ Please send a free copy of Becco Bulletin No. 71.
☐ Please have a Sales Engineer call.

NAME _____

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BECCO CHEMICAL DIVISION, FMC
Station B, Buffalo, New York
Dept. CE-B

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Please tell me more about your Four-Fold Engineering Service.

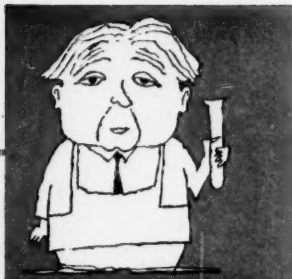
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CITY _____

ZONE _____ STATE _____



What's a PEROXYGEN?

Fact is, "peroxygen" is a word that Becco uses to indicate that we can tie oxygen onto just about anything.

How come? Well, years of experience in producing Hydrogen Peroxide has produced an affinity between Becco and oxygen — an affinity we have capitalized on to give you compounds that will provide a ready source of oxygen — wherever, however and whenever you need it.

We have a good number of such compounds on the shelves. Quite a few others are in development. Still others are merely in our minds, but we can begin drawing them out if you're interested.

We hope you are interested. But we'll never know—unless you fill in the coupon below and mail it to us. Why not?



What's new in Metal Treatments and Etching?

Quite a few things. For example, there's the use of Becco Ammonium Persulfate in etching printed circuits. Seems the material works a lot better — at less cost — and with none of the hazards of the ferric chloride solutions conventionally used.

Then, there's the problem of pickling copper and brass. Lots of pickling agents will do this — only trouble is, you've got to paint or plate or do whatever you're going to do with the metal rather quickly. Or else. Or else it will tarnish or oxidize and you're in the pickle all over again.

Not so with Ammonium Persulfate. Cleans fine. Puts a mild etch on the surface, too, for better paint or plating bonding. More important, perhaps, is the fact that the metal resists retarnishing for up to two weeks. Ideas?

We hope so. What's more, we've got several booklets to help spur you on. They're free—use the coupon below to order.

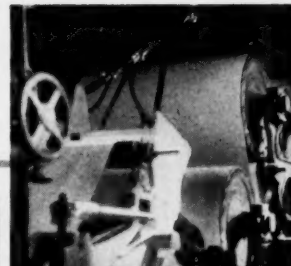
No. 39 and 51—Surface Treatment of Metals with Peroxygen Compounds.

No. 86—Improving Properties of Copper and Brass Surfaces.

No. 97—Paddle Etching of Printed Circuits with Ammonium Persulfate.

No. 99—Tank Immersion Etching of Printed Circuits with Ammonium Persulfate.

No. 102—Etching of Printed Circuits with Mercury Activated Persulfate.



How BRIGHT Is BRIGHT?

That's a hard question to answer. It depends on how the pulp is treated.

Trouble is, paper can show an 86 level at the layboy, but by the time the paper is delivered, this has dropped to 82 or lower. With conventional bleaching methods, that is.

Many chemical pulp producers have found the answer to this problem in Becco's Dryer Steep Bleaching Process (patented, but licensed perpetually for one buck). Applied by means of spray pipes across the pulp sheet ahead of the dryers, Becco Hydrogen Peroxide increases brightness permanence and bleaches in transit. Often, in fact, an 86 layboy level improves to 88 by delivery time.

This is just one example. Becco has a vast amount of technical knowledge compiled from 31 years of experience with all types of pulp. If you'd like help with your pulp, free of any obligation, let us know with the coupon below.

BECCO



BECCO CHEMICAL DIVISION, FMC
Station B, Buffalo, New York
Dept. CE-D

Gentlemen:

Send me more information about Becco Peroxygen Chemicals.

NAME _____

FIRM _____

ADDRESS _____

CITY _____

ZONE _____ STATE _____

BECCO



BECCO CHEMICAL DIVISION, FMC
Station B, Buffalo, New York
Dept. CE-E

Gentlemen:

Please send me the following free bulletins:

☐ 39 and 51

☐ 97

☐ 86

☐ 102

☐ 99

NAME _____

FIRM _____

ADDRESS _____

CITY _____

ZONE _____ STATE _____

BECCO



BECCO CHEMICAL DIVISION, FMC
Station B, Buffalo, New York
Dept. CE-C

Gentlemen:

We would like help with our pulp. Please have a Becco Sales Engineer call.

NAME _____

FIRM _____

ADDRESS _____

CITY _____

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**Now! Ready-to-install
in a single package—**

- High-temperature insulation
- A protective metal jacket
- A built-in vapor barrier

The insulation in Metal-On is Johns-Manville Thermobestos®... finest of all the calcium silicate insulations for service to 1200°F.

From carton to *... with*

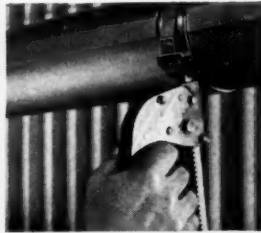
Thermobestos calcium silicate insulation



5 SECONDS TO REMOVE Metal-On from carton. Another 25 seconds to snap on pipe and lock in place!



15 SECONDS LATER the specially designed aluminum "snap strap" (containing vapor seal) has been snapped on joint.



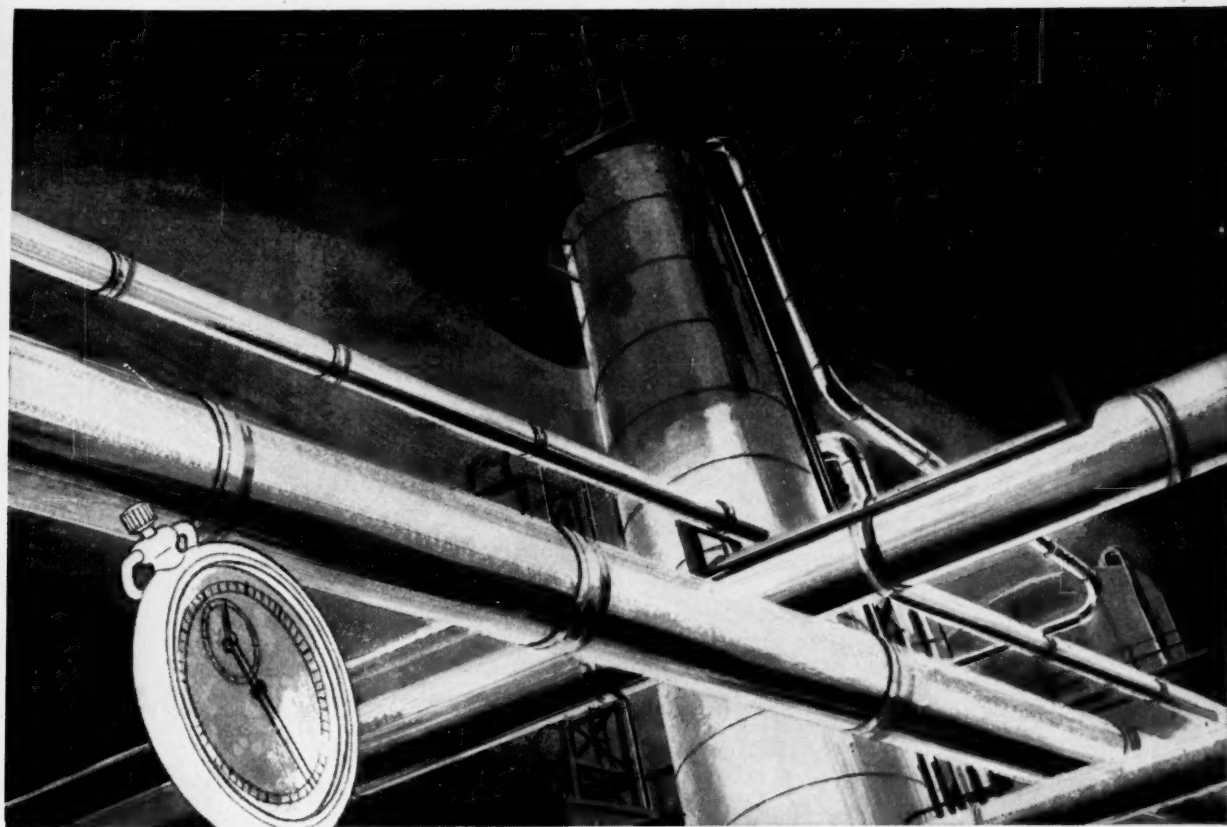
METAL BAND provides perfect joint protection against vapor and weather. Total elapsed time: 90 seconds!

Here's the fastest, most efficient way ever to install high-temperature pipe insulation and protective aluminum jacketing.

Metal-On is the insulation idea all industry has asked for: a single package product that permits application of Thermobestos pipe insulation and corrosion-resistant metal jacket in one fast operation. You'll find that a section of Metal-On can be applied as fast as, oftentimes faster than, an insulation alone.

Snap in place . . . F-A-S-T!

J-M's new Metal-On consists of Thermobestos calcium silicate insu-



Metal-On ends jacket thickness and alloy guesswork! The Metal-On jacket measures an ideal .016-inch thick . . . of a high-quality aluminum alloy selected for superior weather resistance.

pipe in 90 seconds!

new J-M METAL-ON Insulation!

factory-jacketed in gleaming, weatherproof aluminum

lation, a vapor barrier and an all-weather protective covering of aluminum. Furnished ready-to-install, a section of Metal-On snaps on the pipe, locks tightly in place (new locking device is exclusive Metal-On feature) to seal out weather and protect the insulation indefinitely. Joints are sealed tight with aluminum "snap straps" mechanically fastened in place with metal bands.

Right alloy . . . proper thickness

The Metal-On aluminum jacket reduces maintenance in virtually every outdoor pipe application! It never needs painting . . . won't rust . . . is

impervious to surface dirt, oils and grime. The jacketing is made of an aluminum alloy (containing magnesium) that is specially selected for superior corrosion resistance. Jacket thickness is designed to provide, at lowest cost, outstanding appearance, stiffness, workability and resistance to abuse and pitting.

Metal-On presents no fitting problem. It is cut easily right on the job

with either power or hack saws. Available in 36" sections in a complete range of pipe sizes through 24" . . . by 3" thickness.

To help you investigate Metal-On for your next pipe insulation requirement, let us send you the informative brochure, IN-217A. Write for it today. Address Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

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OF MOTOR FACTS
FROM ALL INDUSTRIES



Westinghouse motors double normal life for this application

... at Ohio-Apex Div., Food Machinery
and Chemical Corp.

this standard **Life-Line A** motor
still pumping corrosive POC I₃ after 12 continuous months
without maintenance or down time

"We must have a dependable motor, completely sealed and corrosion-resistant," says Mr. Burton Fitch, Ohio-Apex Division of Food Machinery and Chemical Corporation, Nitro, West Virginia. "A corrosive atmosphere, plus phosphorous oxychloride drip and seepage, cuts motor life. Westinghouse Life-Line® "A" motors have already passed this replacement point twice ... and are still going strong."

Westinghouse motors last longer because they're designed for modern industry's needs. For more facts about the Life-Line "A," call your local Westinghouse representative ... or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

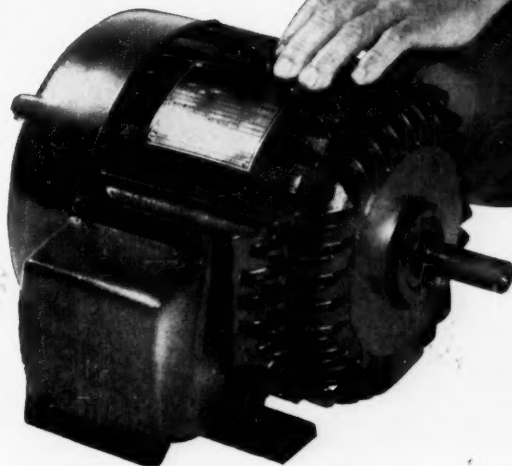
J-22034-R

YOU CAN BE SURE...IF IT'S Westinghouse



Unretouched photo of Life-Line "A" three-hp motor
driving chemical pump at 1730 rpm, 100 gpm at
Ohio-Apex.

"Westinghouse Life-Line "A" motors have cut our motor costs substantially ... helped us keep our chemicals moving down the line," says Mr. Fitch of Ohio-Apex. "Their built-in ruggedness, plus fool-proof sealing against corrosion, means longer life, lower maintenance."



Republic ELECTRUNITE "Dekoron-Coated" E.M.T. still resists corrosion after three years of service at Southland Paper Mills, Lufkin, Texas

Republic ELECTRUNITE® "Dekoron®-Coated" E.M.T. stopped costly corrosion at Southland Paper Mills, Lufkin, Texas.

Previously, standard conduit had to be replaced at frequent intervals in certain locations exposed to tremendous quantities of steam, moisture, and chemical fumes. After three years of service, Republic's extra tough "Dekoron-Coated" E.M.T. is still in excellent condition—has required no maintenance, gives promise of continued years of usefulness.

Here's why: Tough, corrosion-proof polyethylene is applied over the galvanized steel finish. Republic ELECTRUNITE E.M.T. is below this plastic-coat surface. It is produced from highest quality flat-rolled open-hearth steel made in Republic's own mills, carefully inspected to Republic's rigid manufacturing

specifications. Available in a full range of E.M.T. sizes and a complete range of rigid conduit sizes.

"Dekoron-Coated" E.M.T. is easy to install. It can be cut to length and bent to fit with ease. Moisture-tight, continuously grounded, corrosion-protected joints are made by wrapping the threadless connectors and couplings with plastic tape. Complete protection is assured from end to end.

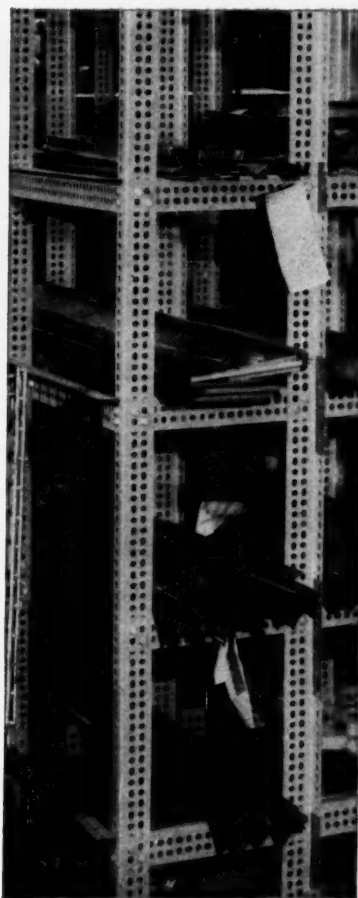
Avoid lost production time and costly delays. Keep essential lighting and power lines operating by using Republic ELECTRUNITE "Dekoron-Coated" E.M.T. in severe corrosive conditions of service. Republic "Dekoron-Coated" E.M.T. meets electrical codes and specifications. For additional data, details, call your Republic representative, or send coupon today.

Republic ELECTRUNITE "Dekoron-Coated" E.M.T. stopped costly corrosion at the Southland Paper Mills, Lufkin, Texas. After three years of service, Republic's extra tough "Dekoron-Coated" E.M.T. is still in excellent condition.

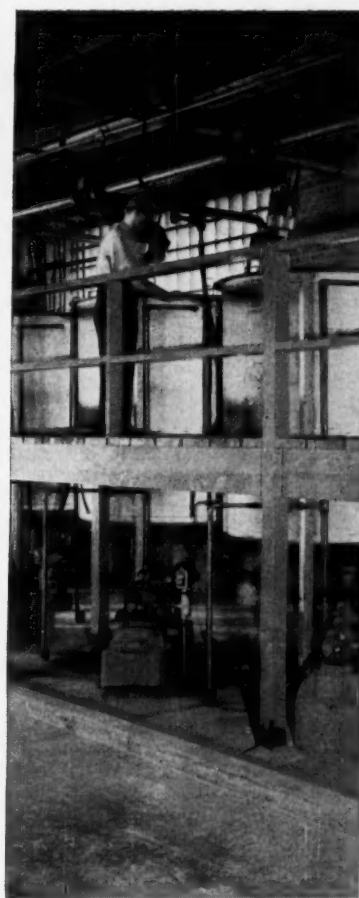




REPUBLIC MATERIALS HANDLING IDEAS save space, cut costs, improve inventory control. Here, Republic Box and Skid Units are used in combination with special hoppers designed by Dresser Industries, Wellsboro, Pa. Opening in front of box hooks and locks on hopper. Lift truck operator trips dumping mechanism with truck forks, eliminates idle machine time. Let Republic help solve your materials handling and storage problems. For complete information, call or write today.



REPUBLIC METAL LUMBER® saves time, space, and money! Precision engineered system of short slots placed to allow $\frac{3}{4}$ " vertical and horizontal adjustment, offers unlimited applications. Simply measure, cut, assemble. Bonderized to resist rust and damage. Baked enamel finish. Delivered in bundles of 10 angles, .080 gage or .104 gage, 10- or 12-foot lengths, bolts and nuts included. Stores in space of one 2" x 4" piece of lumber. Send coupon for idea-packed catalog.



STAINLESS STEEL ASSURES PURE COLORS, UNIFORM QUALITY. This battery of color storage tanks was recently installed by The Chillicothe Paper Company at its paper mills in Chillicothe, Ohio. Fabricated from Republic ENDURO® Stainless Steel, the tanks are indicative of Chillicothe's widespread use of modern stainless steel equipment in producing a wide variety of quality products. You, too, can enjoy the many advantages and economies of stainless. Call your equipment supplier.

REPUBLIC STEEL



*World's Widest Range
of Standard Steels and
Steel Products*

REPUBLIC STEEL CORPORATION
DEPT. CE-6444
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send me information on the following:

- ☐ Republic ELECTRUNITE™ Dekoron-Coated™ E.M.T.
- ☐ Republic Materials Handling Equipment
- ☐ Republic METAL LUMBER
- ☐ Republic ENDURO Stainless Steel

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

POSITIVE, TIGHT VALVE CLOSURE...

under all variations of Temperatures and Pressures



New TYPE SA **LimiTorque** WITH COMPENSATING SPRINGS

Correct seating of the valve is extremely important during automatic valve operation, especially where fluctuation of high line temperatures are encountered.

To assure an absolutely tight seat, the new LimiTorque Type SA Unit incorporates unique compensatory springs which, literally, "take up" any amount of contraction or expansion caused by decreasing or rising line temperature.

These springs of Belleville Disc type vary in number for use in either parallel or series, within fixed limits, to provide the desired compensation. The result of continual improvement and development, the Type "SA" LimiTorque contains all the features of the famous Type SMA unit plus a simple indicator to show the amount of compensating spring compression. Available in Weather-proof and Explosion proof construction, these units can be mounted on any size valve in almost any position.

For information and data, write for Bulletin 4-57.

* Simple indicator always shows amount of compensating spring compression.

features:

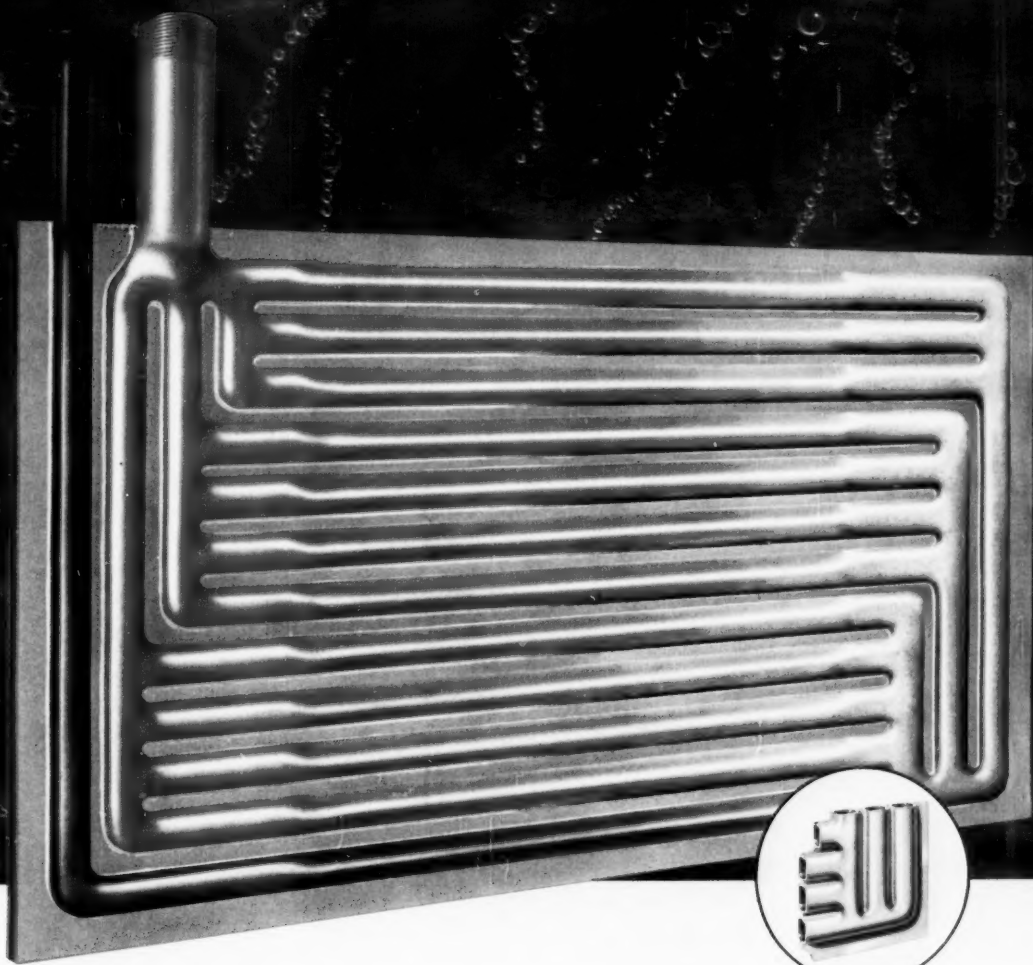
- Controlled thrust applied to valve operating parts.
- Greater torque, thrust and stem capacity.
- Easier handwheel operation.
- Two piece stem nut design permits changing unit from one valve to another.
- Torque control for both directions of stem travel or single direction as required.
- Lubricant sealed in for life of unit.
- Simple indicator which always indicates amount of compensating spring compression.

THERE IS NO SUBSTITUTE FOR -

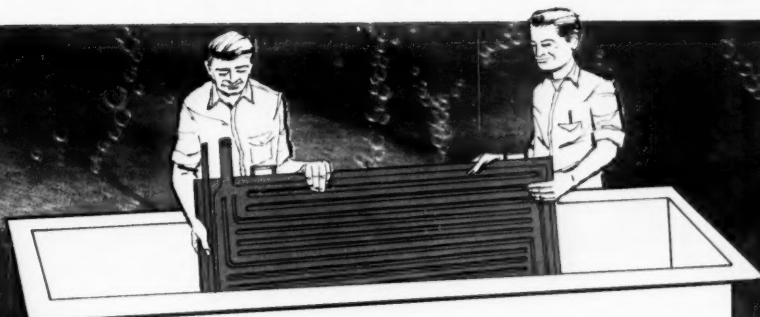
LimiTorque®

PHILADELPHIA GEAR CORPORATION
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS
LimiTorque Corporation • Philadelphia



NEW MULTI-ZONE PLATECOIL[®]



*An exclusive Tranter advancement
in heat transfer technology*

*Patents applied for

**NOW, more than ever, a complete range of
heating and cooling applications
is possible with PLATECOIL®**

Higher pressure ratings

Now, the time-proven advantages of PLATECOIL over pipe coils can be applied to a new range of heating and cooling problems requiring operating pressures up to 250 p.s.i. Styles, sizes and metals are available to fit the requirements of all types of process tanks as well as waste heat recovery, oven and furnace, heat screen and similar applications.

Save on engineering, installation and maintenance

Factory-fabricated PLATECOIL is easy to engineer. Standard data on heat transfer capacities and performance characteristic of PLATECOIL eliminates time-consuming computation of pipe coil requirements. High BTU transfer per unit area as compared with pipe coils results in the use of less equipment by volume to save valuable tank space. Lightweight PLATECOIL units are easy to handle for fast, economical installation or removal for cleaning. Streamlined design tends to retard the build-up of deposits on the plates and makes cleaning an easy operation. Electric welded and pressure tested, PLATECOIL units have no threaded joints to corrode or leak. Simple connections can be located above the liquid level.

NOW OPERATING PRESSURES UP TO 250 PSI

Higher pressure containment is the result of design and construction refinements achieved exclusively by TRANTER. New TRANSTEEL mild steel in standard PLATECOIL units, DURAWELD bonding of plates, plus MULTI-ZONE coil configuration represent a new scope of PLATECOIL versatility and performance poten-

tial. Laboratory tests to destruction have demonstrated a safety factor of more than 5 to 1.

Get the facts now on new operating characteristics of the complete PLATECOIL line.

SEND FOR NEW PLATECOIL Bulletin No. P61



 **Tranter Manufacturing Inc.**

LANSING 9, MICHIGAN

PLATECOIL®
DIVISION

HOW *HERCULES* HELPS...

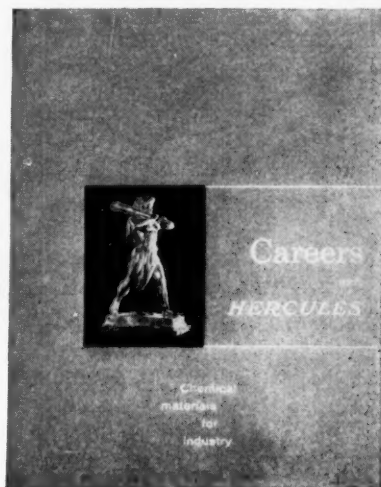


AIRPORTS FOR THE JET AGE—A record billion dollars will be spent in 1959 on new and enlarged military, municipal, and private airports to meet air transport and defense needs. Hundreds of miles of lengthened, widened runways

to handle jet liners will be built with "air-entrained" concrete for greater durability. Vinsol® resin air-entraining agent has been widely specified for such uses since the concept was introduced by the cement industry in the 1930's.

TECHNICAL GRADUATES—

This year's seniors who are interested in a career in the chemical industry will find this new booklet a complete explanation of opportunities at Hercules. The company's growth, its diversified products and markets, its training program for new employees, are all covered. Inquiries from qualified students will receive prompt attention from our Personnel Department, which uses the booklet in their recruiting program with college placement offices.



MAKE PAINTING EASY—Today's new "dripless" or gelled paints make painting anything, even ceilings, practically a pleasure. T. F. Washburn Co. of Chicago relies on Hercules Improved Technical PE as an essential ingredient in its patented Burnok vehicle. The Burnok vehicle, made with this quality pentaerythritol, gives full viscosity control, produces a paint that brushes easily and covers completely with a minimum of dripping.



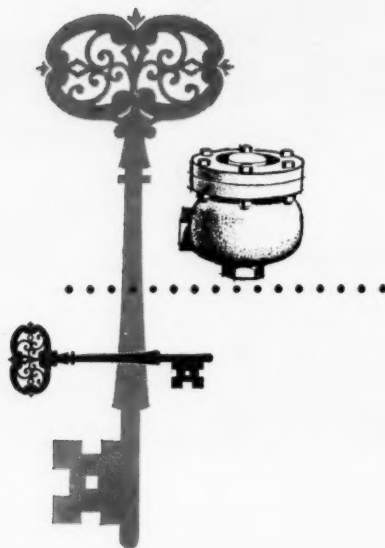
059-1

HERCULES POWDER COMPANY
INCORPORATED

900 Market Street, Wilmington 99, Delaware

HERCULES

Who Holds the Key in Turnkey?



Not the consulting engineer.

Not the prime contractor.

Not the subcontractors.

Not even the customer's representative who, assigned to build a plant and stay within the building budget, is too often willing to forfeit the future for a good cost showing today.

The key to this plant's productivity and profits is held solely by the *owners*.

The owners must, of necessity, think in terms of how much this plant will produce, and at what cost. They must, of necessity, think of *total cost*.

Total cost includes the price of original equipment, the

expense of installing it, and how much it costs to maintain it over the entire useful life of the plant.

Take steam traps, for example. Lots of traps cost less than Nicholson's. In a box on the jobber's shelf, that is.

But when the plant *owners* have paid the cost of installation, and "dry, clean steam" has been contaminated by everything from weld bead to broken beer bottles and the *owners* have paid the cost of that, and finally when the "bargain" traps have broken down in service—the *owners* call on Nicholson.

Quality Nicholson steam traps, sometimes higher in initial cost but always lower in installed cost, have long enjoyed the reputation of being the *owners'* favorite—the favorite of the people who, in the long run, have to pay the bill.

ST-100

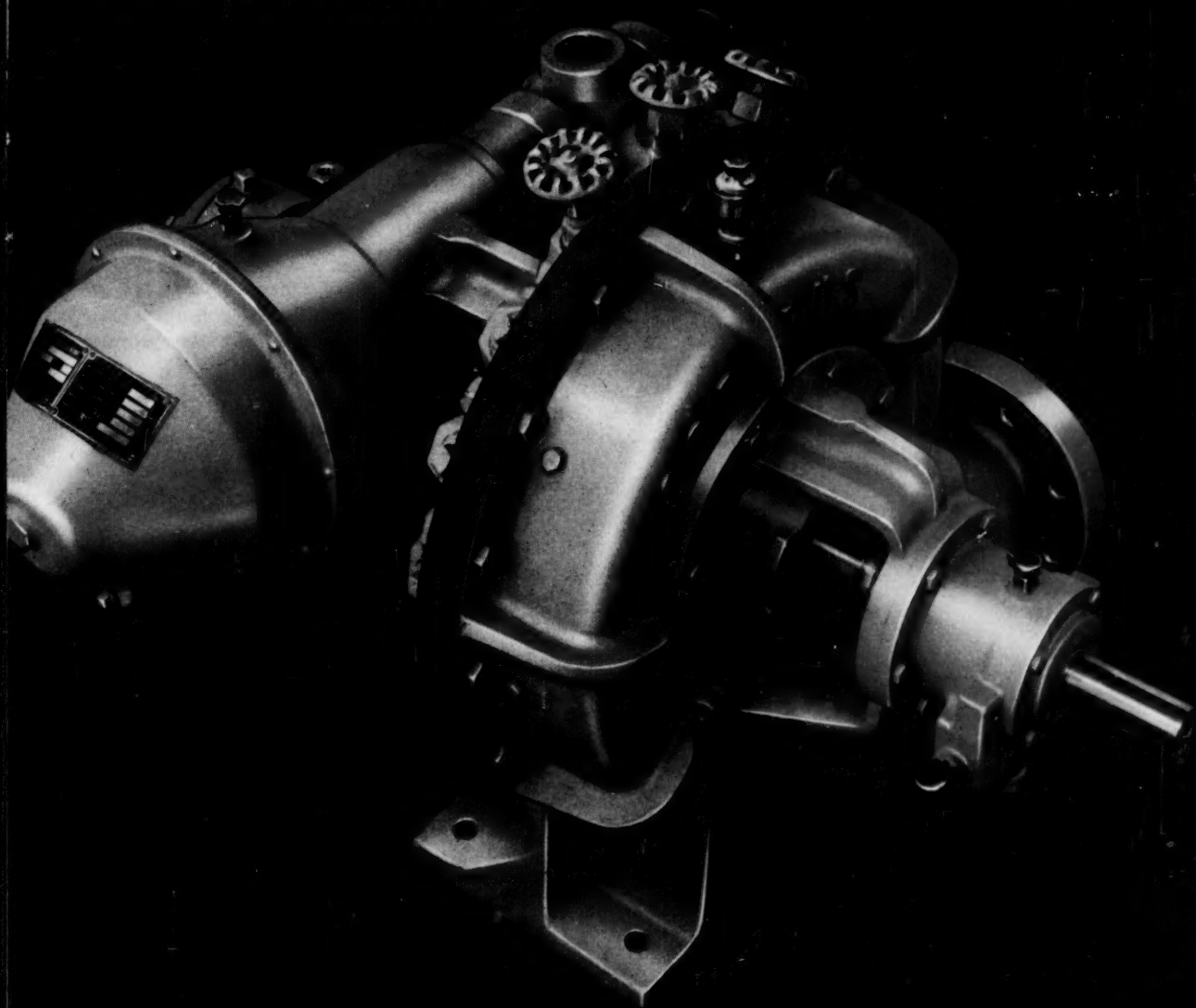
NICHOLSON

OF WILKES-BARRE

W. H. Nicholson and Co. • 16 Oregon Street • Wilkes-Barre, Pa.
Distributors in all principal cities

COPPUS

BLUE RIBBON PRODUCTS



Coppus Horizontal Steam Turbine

NEW RUGGED DESIGN—BLUE RIBBON RELIABILITY!

Here's a new dimension in turbine performance! Coppus brings you a new rugged stability of design . . . a new measure of reliability in a complete range of power-packed turbines, from 1 HP to 250 HP — marked with the Blue Ribbon only after each is precision made . . . precision tested. Performance features like these assure you Blue Ribbon Reliability —

A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.

Coppus Turbines are built to customers' specifications, including API and NEMA standards. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 222 Park Avenue, Worcester, Mass. Sales Offices in *Thomas' Register*.



COPPUS
STEAM TURBINES

ENGINEERS "DISCOVER" ALCOA CONDUIT

Lower cost, installation economies, corrosion resistance make Alcoa Aluminum the best conduit buy. An increasing number of cost-conscious engineers are switching to aluminum rigid conduit for office buildings, industrial plants and other new and remodeled structures. Here are some of the reasons why:

- Lower prices plus light weight and ease in handling make Alcoa® Aluminum Conduit installations competitive.
- Corrosion resistance of aluminum means less maintenance, freedom from staining.
- Aluminum is easier to cut, bend and thread. Wire pulling is easy, too, because of specially treated internal surface.
- Nonmagnetic aluminum offers up to 20 per cent less voltage drop.

- Clean, modern appearance complements modern architecture.
- Aluminum is nonsparking and has Underwriters' Laboratories, Inc., approval.

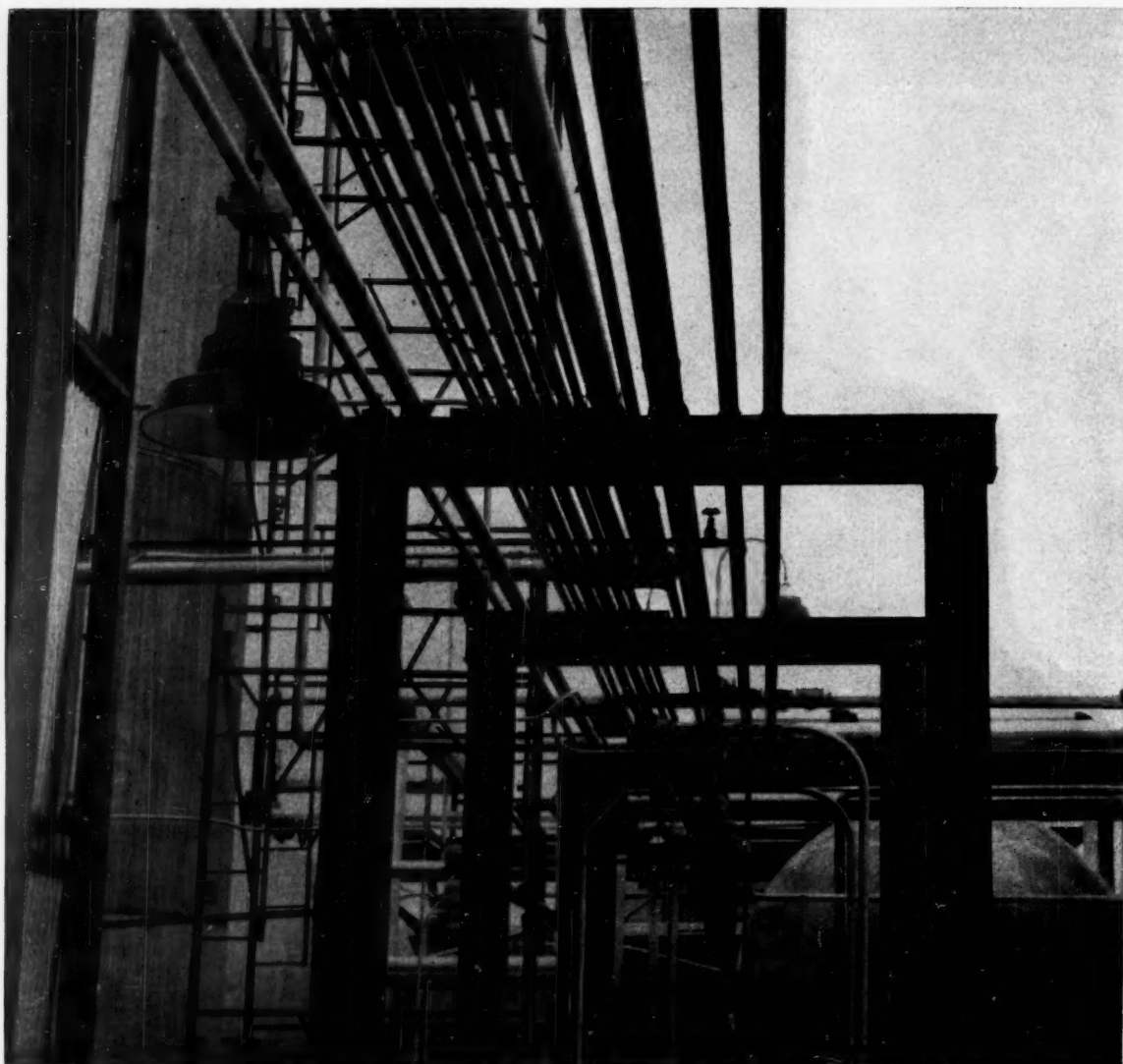
Find out why Alcoa Aluminum is your best conduit buy. Contact your electrical distributor, or write Aluminum Company of America, 2147-B Alcoa Building, Pittsburgh 19, Pennsylvania.

For Exciting Drama Watch "Alcoa Theatre," Alternate Mondays NBC-TV and "Alcoa Presents," Every Tuesday, ABC-TV



Ask for your Free Copy of New Booklet on Alcoa Aluminum Conduit

The Texas Company, Lockport, Illinois



*for Quality that
goes more than
skin deep...*

**INSIST
ON**
Killark
**ALUMINUM
CONDUIT
FITTINGS**

Weatherability and durability are cast right into every Killark Electrolet—not just on the surface.

You can specify with complete confidence, because Killark Electrolets are designed for extra strength at points of stress, and made of an alloy that scientifically balances lightweightness with strength.

Killark manufactures a complete line of UL and CSA approved Explosion-Proof, Vapor-Proof and Dust-Tight fittings and fixtures.

Write for the Killark Catalog of
Electrical Fittings
and Fixtures



Killark



Plated or Dipped
Cast Iron Fitting—
Protection is Only
Skin Deep.

Killark
Solid Aluminum
Electrolets—Give
Protection Clear Through.

the cross section tells the story

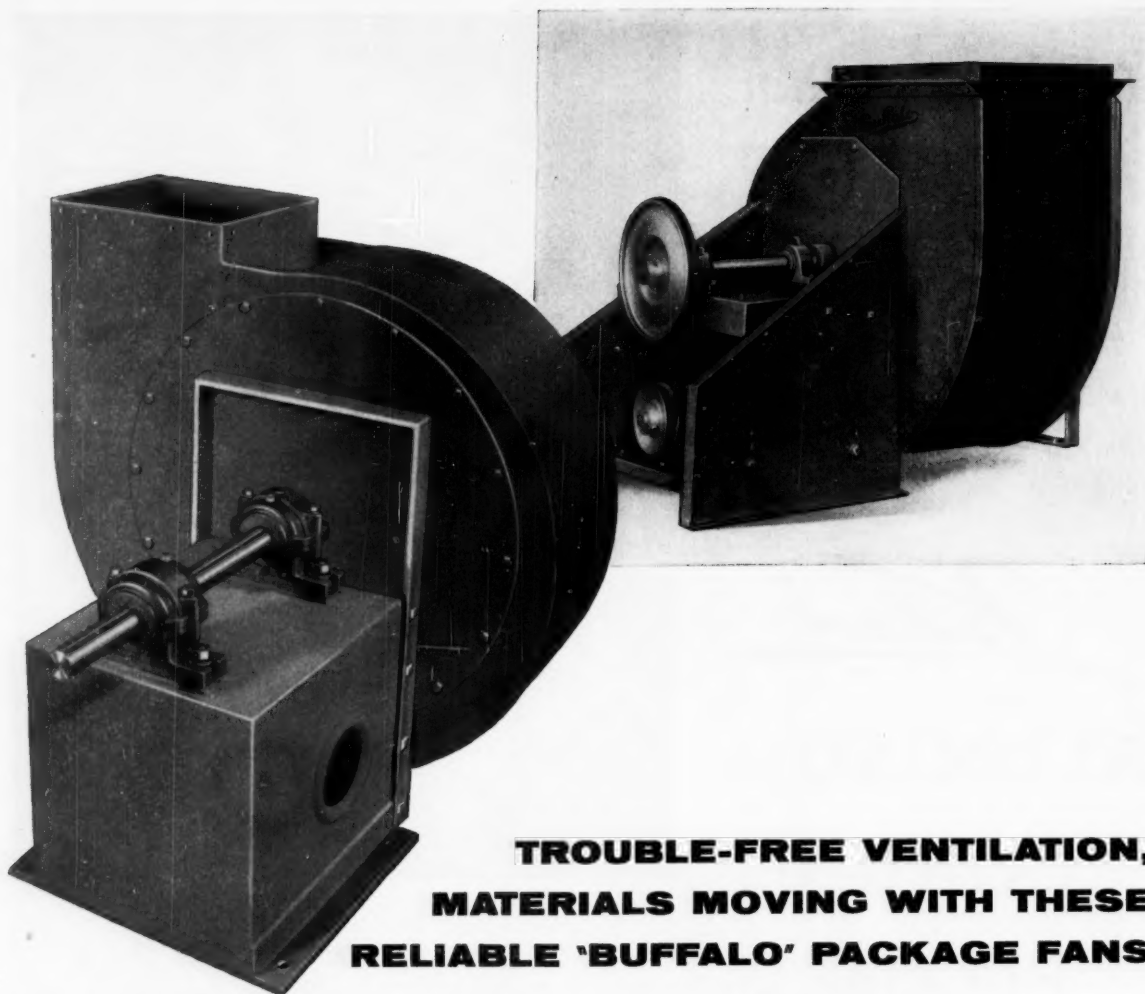
The slice across the cast iron fitting above quickly shows you why a coating or plating is only temporary protection at best. Regardless of how well and how carefully applied, this surface requires only the slightest scratch or nick to open the door to expensive rust and corrosion.

The Killark Electrolet is solid aluminum, alloyed with other metals to give strength and ductility . . . it can't ever rust and has much more resistance to corrosion.



ELECTRIC MANUFACTURING CO.

Vandeventer and Easton Aves. St. Louis 13, Mo.



TROUBLE-FREE VENTILATION, MATERIALS MOVING WITH THESE RELIABLE 'BUFFALO' PACKAGE FANS

'BUFFALO' INDUSTRIAL EXHAUSTERS

"Buffalo" Industrial Exhausters are available in a wide variety of models, capacities and arrangements to handle your most demanding air or material handling jobs with the utmost efficiency and dependability. The heavy welded steel plate housing is adjustable to any desired direction of discharge. Ease of maintenance is assured by the removable front and back plates. The several arrangements in the line include both belted and direct-connected drives. The 8-bladed, all-welded air wheel effectively exhausts hot air, gases, fumes and light dust. Corrosion-resistant construction can be specified. Two types of material wheels cover all exhausting requirements, from emery dust, sawdust, paper, and chips to long shavings and other stringy substances. Capacities range from 600 to 37,000 cfm.

There's a rugged, reliable "Buffalo" Industrial Exhauster to fit most air or material handling requirements. Call in your "Buffalo" Representative, or write for full information in Bulletin 3576-B.

Every "Buffalo" product features the famous "Q" Factor—the built-in QUALITY that provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING	AIR CLEANING	AIR TEMPERING	INDUCED DRAFT	EXHAUSTING
FORCED DRAFT	COOLING	HEATING	PRESSURE BLOWING	

'BUFFALO' BELTED VENT SETS

Where low initial and operating costs are important... where a quiet fan is necessary... where a "package" unit is desirable... more and more industrial users are turning to "Buffalo" Belted Vent Sets. These versatile units are especially adaptable to smaller system requirements, or for use when central system ventilation requires augmentation. They offer quiet, stable performance, high efficiencies and the non-overloading characteristics of the largest "Buffalo" Fans. A lightweight package, they can be quickly and easily installed indoors, outdoors or as power roof ventilators. Available in capacities from 500 to 20,000 cfm (capacity can be modified at any time by changing motor or fan pulleys).

"Buffalo" Belted Vent Sets may be the economical answer to your smaller system ventilation needs. Contact your nearest "Buffalo" Engineering Representative, or write for Bulletin 3720-A.



ALLIS-CHALMERS

NEW grinding plant

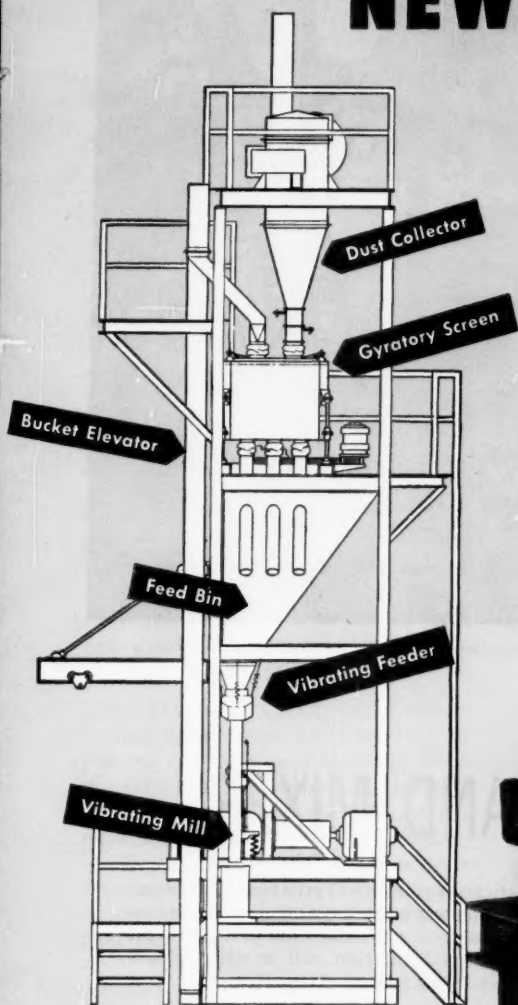
15 to 30 times more capacity

50% less space required

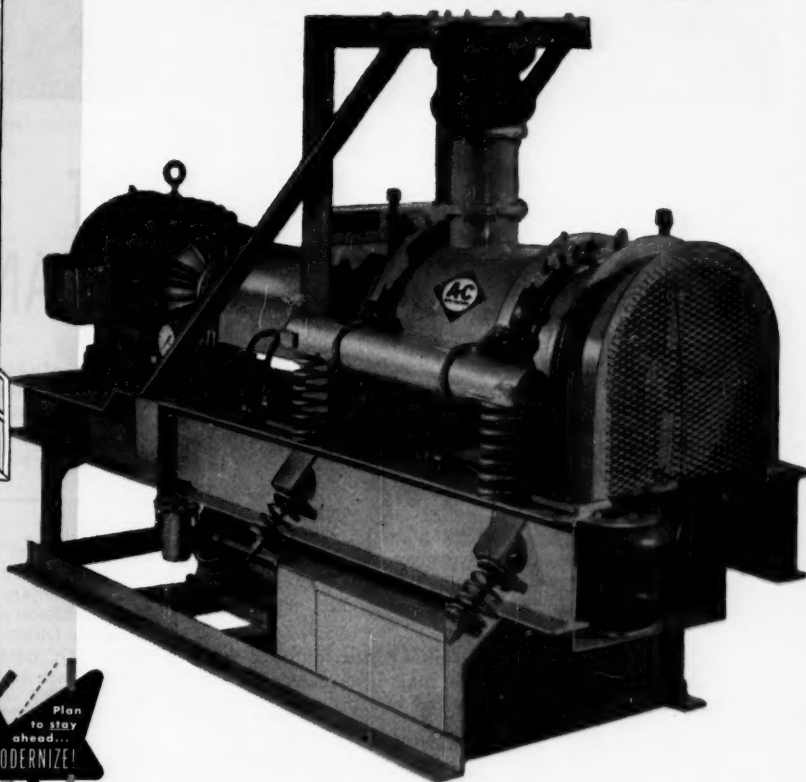
a complete "package" — at a surprisingly low cost

You can now process as much as one ton per hour of dry materials within less than 127 square feet of floor space with this new Allis-Chalmers Grinding Plant. Plant components are designed, applied and "coördineered" to handle materials in a 30 to 300 lb per cu ft range. Vibrating mill out-produces a tumbling mill 15 to 30 times per unit volume. The plant is a complete pre-engineered "package" that affords the low price tag of an off-the-shelf item, and built-in flexibility offers tailored-to-the-job performance.

Operating economy, accessibility, cleanliness and easy maintenance of the entire plant are other advantages.



Plant includes structural steel, platforms, ladders and processing equipment, motors, and drives — everything match-marked for convenient erection.

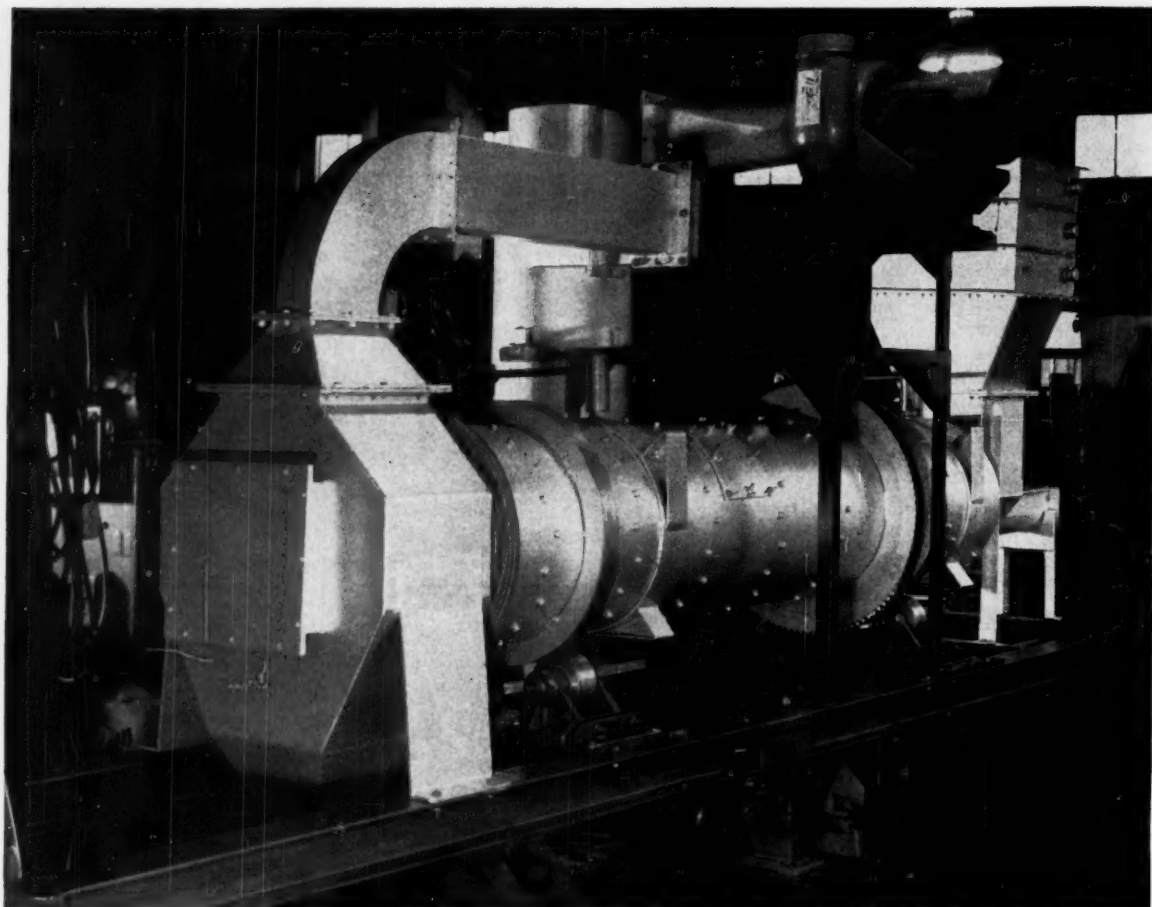


Your local A-C man will give you all the details. Or, write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.



A-5849

ALLIS-CHALMERS



Pilot-scale Louisville Dryer available on rental or purchase basis

FOR RENT PILOT PLANT DRYERS AND MIXERS

Rent this equipment when

1. The material changes physically or chemically on aging.
2. The material is hazardous and requires special handling by your own personnel.
3. Long duration tests are required for equipment evaluation.
4. Completion of a pilot plant is required at no additional capital expense.
5. Product security prevents release of samples.
6. Large quantities of finished product are needed for application studies.

Units are fabricated of stainless steel and are self-contained. Rental charges may be applied against purchase of production-sized equipment.

General American engineers will give technical assistance. If in-plant testing is not required, you can predetermine results at our complete East Chicago pilot plant. For further information, call or write. You'll find, *it pays to plan with General American.*

Available:

Louisville Steam Tube Dryer	(1' x 8')
Louisville Rotary Reactor	(1' x 8')
Louisville Rotary Solvent Stripper	(1' x 8')
Louisville Rotary Vacuum Dryer	(1' x 8')
Louisville Direct Heat Dryer	(1' x 8')
Turbo RDC Extraction Column	
Turbo Bench Scale and Small Pilot Mixers	

GENERAL AMERICAN TRANSPORTATION
Process Equipment Division

135 South LaSalle Street, Chicago 90, Illinois
Offices in Principal Cities

In Canada: Canadian Locomotive Co., Ltd., Kingston, Ontario



**Louisville Dryers
CORPORATION**



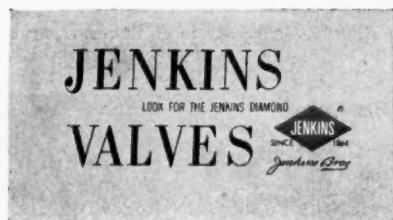
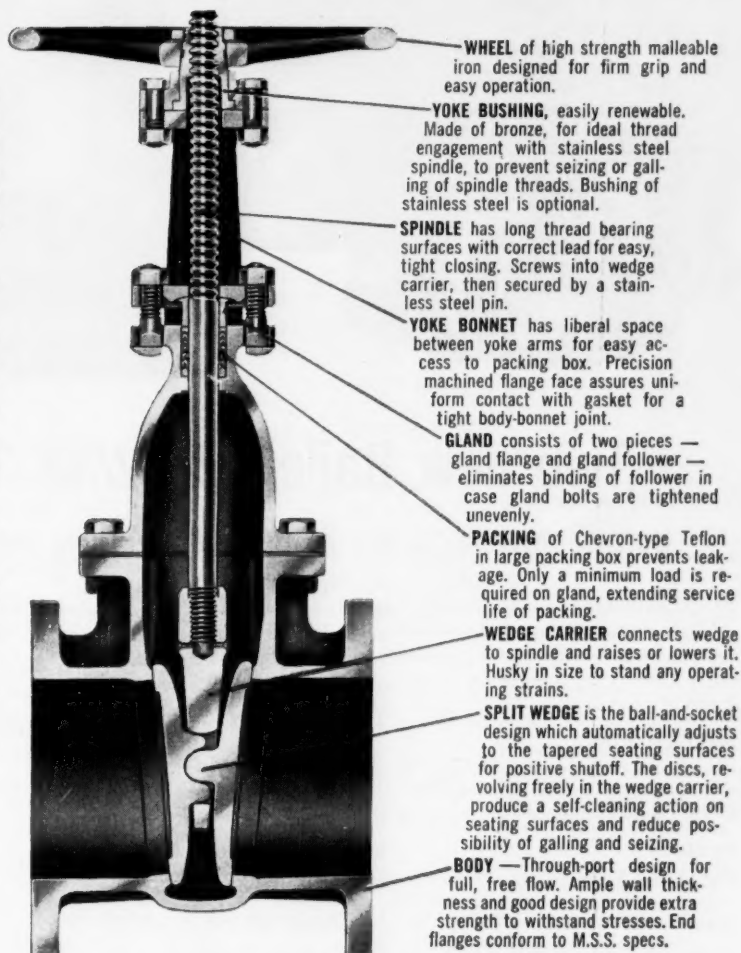
In this Split Wedge Gate
you can see why it pays to

Specify JENKINS for STAINLESS STEEL Valves, too

This picture shows the many points of excellence in the design and construction of Jenkins Fig. 1327 Split Wedge Stainless Steel Gate Valves. Compare them with any valve you know. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves. You'll find in it the patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services. Also, you'll see that these Jenkins valves meet valve industry specifications and the high standards established by the leading users of stainless steel valves. Jenkins Bros., 100 Park Avenue, New York 17.



Sold Through Leading Distributors Everywhere



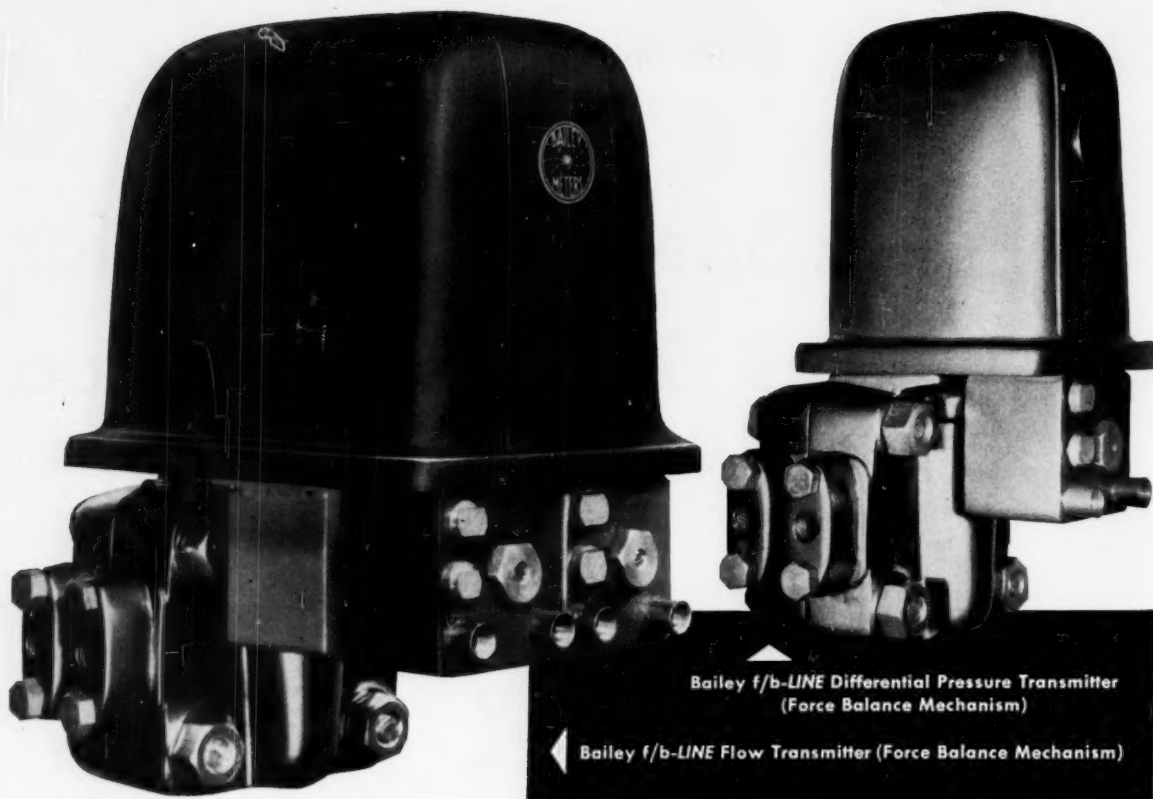
JENKINS BROS., 100 Park Avenue, New York 17, N. Y.

- ☐ Send the new stainless steel valve catalog
- ☐ Have a representative call on me

NAME & TITLE.....

COMPANY.....

ADDRESS.....



Bailey f/b-LINE Differential Pressure Transmitter
(Force Balance Mechanism)

Bailey f/b-LINE Flow Transmitter (Force Balance Mechanism)

Two new Bailey *f/b-LINE* Transmitters permit new accuracy in measuring flow and differential pressure

Pneumatically transmits rate of flow—or differential pressure—measurements to indicating, recording, and/or controlling equipment at remote stations. Transmitters consist of a diaphragm measuring mechanism and a force balance pneumatic transmitting unit.

APPLICATION

For steam, water, air, gases and other fluids producing differentials across primary elements from 0-2 in. H₂O to 0-2000 in. H₂O at maximum service pressure of 50, 1500, and 5000 psig.

FEATURES

Transmits a Signal Directly Proportional to Rate of Flow. Uses receiver with uniformly-graduated chart or scale. Eliminates need for external square-root extractors or characterizers.

10 to 1 Turndown. Differential range of each diaphragm measuring element may be changed by factor of 10 to 1; e.g., 0-20 in. H₂O diaphragm may also measure 0-2 in. H₂O.

Screwdriver Adjustments. Range and zero adjustments readily accessible. Range may be changed with screwdriver adjustment.

Overpressure Protection. Protects against full service pressure applied to either side of diaphragm.

Fast Response. No viscous dampers needed, so speed of response is very fast.

Corrosion Resistant. For maximum differentials between 20 and 2000* H₂O, all parts in contact with process fluid may be stainless steel. No sealing fluids or sealing diaphragm required.

Good Stability. Reset type boosters give good stability with high gain.

Versatile Mounting. May be mounted on process piping, wall, or separate mounting pipe using same bracket.

For additional information, call your local Bailey District Office, or write direct.

CP3-1

Chemical and petroleum division

BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal



NOT ONE FIELD CUT

in all This

MIDWEST

Shop-Fabricated

Piping



and I would like to say the West Coast Division have on this job complied fully with the high standards of workmanship for which Midwest is known.

Throughout this entire project not once was a cut necessary to correct any piece of fabrication, and I might add in several instances close tolerances had to be met.

The above was not written on an impulse but as construction superintendent, this means but one thing: fast and low cost erection. Would appreciate your thanking Midwest personally for a job from a construction

Excerpt from letter by:

HOLMES & NARVER • Engineers-Constructors
828 South Figueroa St. • Los Angeles 17

Note particularly the words "fast and low cost erection" in the above letter. They characterize Midwest Shop-Fabricated Piping... whether for refinery, power plant or industrial installations. In this instance they were written by A. H. Chamberlain, construction superintendent, upon completing the installation of a Houdriformer Unit at the U.S. Oil & Refining Co., Tacoma, Washington.

There are three well-equipped Midwest pipe fabricating shops located to serve economically all sections of the country. Each is staffed by a highly skilled organization using the latest techniques. Each has wide experience on all kinds of projects so that the possibilities and limitations of all piping materials are well understood. You too will find it to your advantage to call in Midwest whenever you need fabricated piping.



MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Missouri (P.O. Box 433)

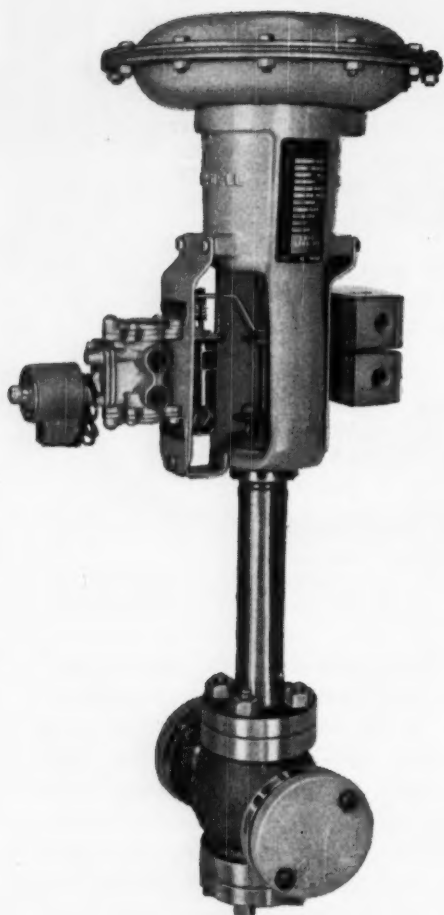
Plants: St. Louis, Clifton, N.J. and Los Angeles

SALES OFFICES:

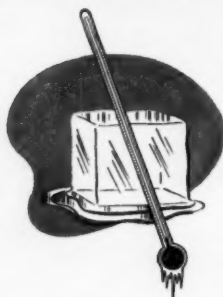
ASHEVILLE (BOX 446, SKYLAND, N. C.) • ATLANTA 9—72 11th ST., N.E.
BOSTON 27—426 FIRST ST. • CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE • HOUSTON 2—1213 CAPITOL AVE.
LOS ANGELES 33—320 ANDERSON ST. • MIAMI 34—2103 LE JEUNE RD.
NEW YORK 7—50 CHURCH ST. • PITTSBURGH 19, PA.—437 GRANT ST.
ST. LOUIS 4—1450 S. SECOND ST. • SAN FRANCISCO 11—420 MARKET ST.
TULSA—1640 E. 21ST ST.

is your

PROCESS FLOW COLD?



**Honeywell control valves are available
for a wide range of temperatures**



Whether you're concerned with minus 450 or 1200°F, there's a Honeywell automatic control valve for your process flow. The Honeywell valve illustrated—Series 800, Type 12 single seated—is designed for liquid oxygen service. Thoroughly degreased and sealed, it includes such features as: bronze bush-

ings . . . stainless steel body and trim . . . seal-welded seat ring . . . low-temperature bolting . . . non-lubricated, Teflon-impregnated, blue asbestos packing . . . designed clearances for non-sticking, non-galling operation.

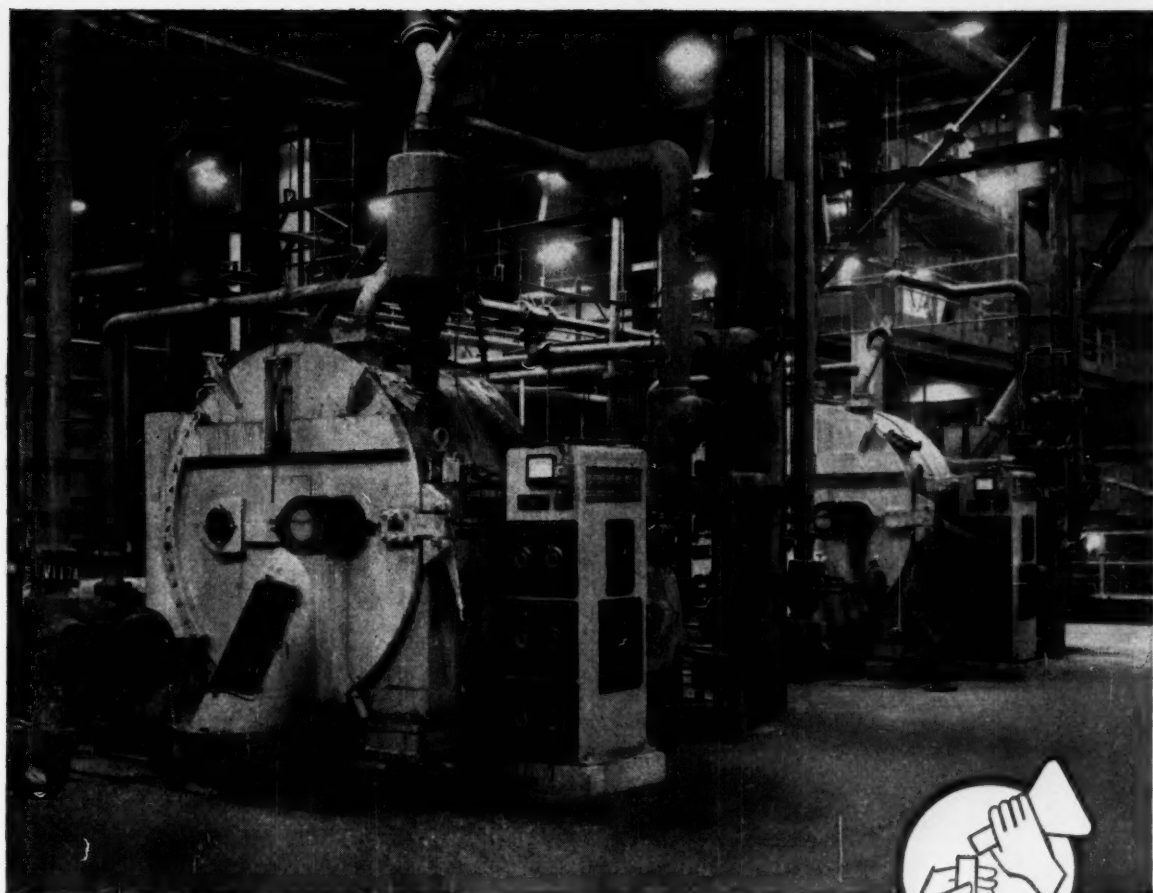
For hot or cold flows . . . or other process flow conditions . . . Honeywell valves are available in a wide range of types and sizes. When you need control valves . . . contact your local Honeywell field engineer. Write for new Catalog C800-1.

MINNEAPOLIS-HONEYWELL, Fort Washington, Pa.

Honeywell



First in Control



B-P CENTRIFUGALS used by ELECTRO METALLURGICAL COMPANY in Titanium Production

Although a metal, titanium is produced by a chemical process. Metal in the form of ore is converted to titanium tetrachloride, which is purified and then reduced to metallic sponge by sodium. In order to separate the brine from the titanium sponge, Electro Metallurgical Company, Division of Union Carbide Corporation, New York, utilizes Baker Perkins 66" diameter type HS Universal Centrifugals. It's a tough application, but the B-P Type HS has proven itself efficient and dependable. These same machines are adaptable to a wide range of filterable fine solid-liquid slurries. Baker Perkins also manufactures type S Continuous Centrifugals which are used extensively for the separation of filterable coarse solid-liquid slurries.

Since centrifugation is such an important process in the

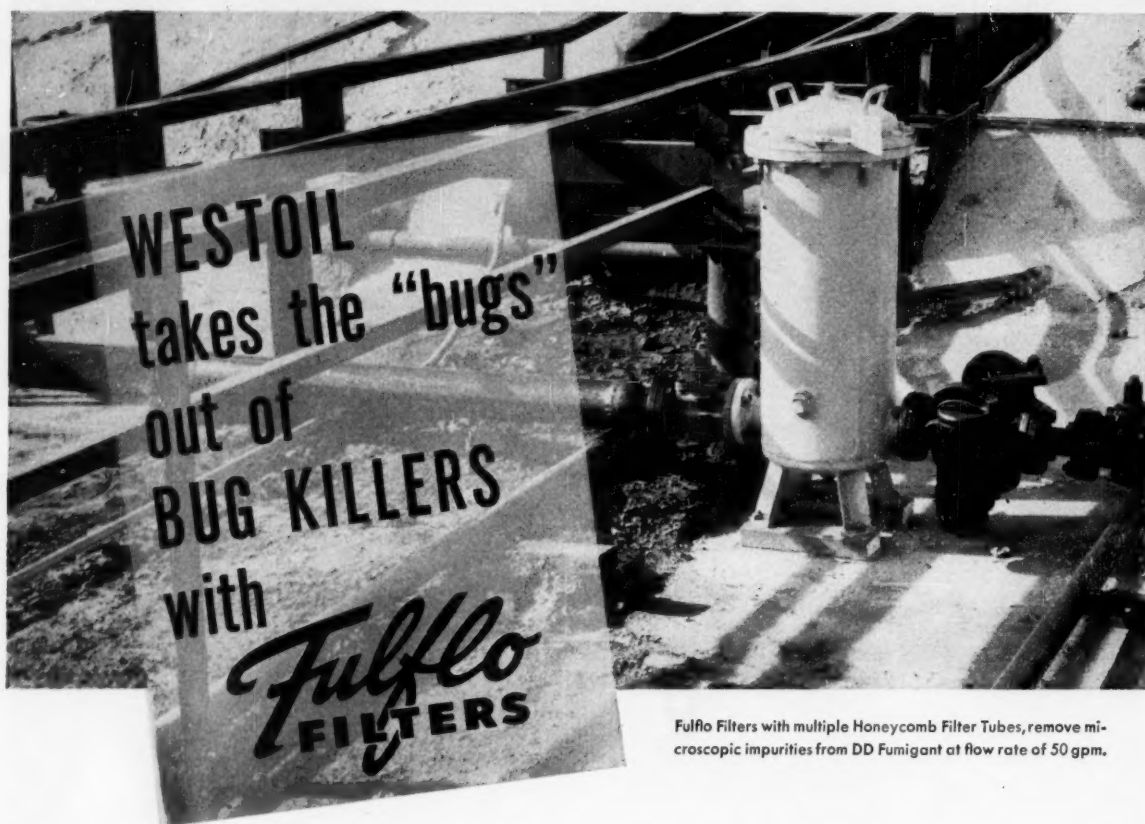
chemical industry, and, since there are so many types of slurries that must be separated, Baker Perkins engineers give special design consideration to each specific problem. No matter what factors are involved in each application, our engineers can make recommendations on the proper centrifugal machinery.

Send for your copy of Catalog
CE-58 for complete information
on size, type and capacities of Baker Perkins "Ter
Meer" Centrifugals.



BAKER PERKINS INC.

CHEMICAL MACHINERY DIVISION
SAGINAW, MICHIGAN



Fulflo Filters with multiple Honeycomb Filter Tubes, remove microscopic impurities from DD Fumigant at flow rate of 50 gpm.

Westoil Terminals Company ships deadly DD Fumigant to fight vicious tropical insects at South Pacific military installations. As the potent insecticide flows into drums, Fulflo Filters remove microscopic rust, dirt, and other impurities. This eliminates any danger of clogging or scoring the fine nozzles used in injecting the fumigant into the ground.

Fulflo Filters with genuine Honeycomb Filter Tubes, improve product quality, reduce downtime, prolong equip-

ment life and increase production in a variety of operations. You get any desired degree of micro-clarity for all types of industrial fluids: liquid chemicals; pharmaceuticals; water; oils; liquid fuels; compressed air, CO₂ and other gases. They give true *depth* (not just surface) filtration, at minimum pressure drop, for high or low flow rate, pressure, pH, temperature and viscosity. Complete engineering facilities are at your service.

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MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST



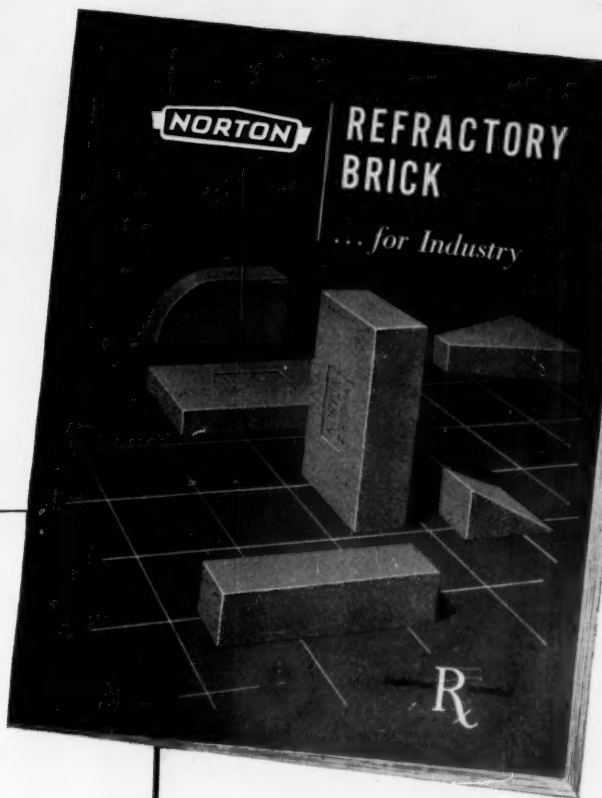
with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.



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Send for this New Booklet to Help Improve Your High Temperature Processing

Covers Norton refractory brick applications, characteristics, chemical analyses — includes helpful data on materials of construction for temperatures up to 4,400°F.



This new, 24-page Norton booklet can be a dependable guidebook for your selection of the refractories you need to improve production and cut costs in high temperature processing.

Eight Norton-developed refractory materials are covered: ALUNDUM* "T" 87% Alumina; ALUNDUM "A" 99% Alumina; ALUNDUM "L" 99% Insulating Alumina; CRYSTOLON* "G" Silicon Carbide; CRYSTOLON "N" Nitride Bonded Silicon Carbide; MAGNORITE* "K" Fused Magnesia; Zirconia "H" Dense Zirconia; Zirconia "I" Insulating Zirconia.

All essential details are listed, such as: how each material is produced . . . important properties, characteristics and chemical analyses . . . shapes of brick and other molded products that are available . . . representative applications . . . packing methods that assure safe arrival.

Also included are charts and tables of brick shapes and sizes, thermal expansion and conductivity graphs, and a temperature conversion chart.

Norton refractories — engineered and prescribed for the widest range of applications — have helped many users save time and money. The R's described in "Norton Refractory Brick . . . for Industry" may do the same for you. Write for your copy to NORTON COMPANY, Refractories Division, 501 New Bond Street, Worcester 6, Massachusetts.



*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

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"larger load capacity, good load-carrying balance and faster delivery"



Model H-25 is the only tractor-shovel in its class having power-transfer differential, and power-shift transmission with two speed ranges in both forward and reverse.

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* **"Operators like the ease of operation too,"** adds Ben Lipscomb, Supt., Kentucky Fertilizer Works, Winchester, Ky.

"We have been using "PAYLOADER" tractor-shovels better than 9 years with exceptionally good production records" says Mr. Lipscomb. "We find they stand up under tough duty work with minimum repairs. Each new Hough has advanced design that gives more plant efficiency over previous models."

The extra "load capacity" to which he refers is the 2500 lb. carry capacity — 500 lb. more than previously available in a machine of this class. The "ease of operation" and "faster delivery" are products of power-steer, power-shift transmission (no clutching), greater engine power, 4,500 lbs. of breakout force and shortest turning radius of 72 in.

There are many other reasons why the H-25 will dig, carry and deliver more tonnage with lower operating and maintenance costs than anything in its class.

It has extraordinary protection against dust and dirt damage: triple air cleaners — precleaner and two oil-bath air cleaners; cartridge-type oil filters on the three oil systems; sealed self-adjusting hydraulic service brakes; parking brake enclosed in transmission; special oil and grease seals on all vital points.

Ask your "PAYLOADER" Distributor for a demonstration of the great new Model H-25.

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And it is precisely this skill and experience in creative engineering that distinguishes a Stone & Webster project... whether it's a chemical plant, refinery, power station or pulp and paper mill. For nearly 70 years Stone & Webster has been associated with *profitable* engineering projects of every size in nearly every industry.

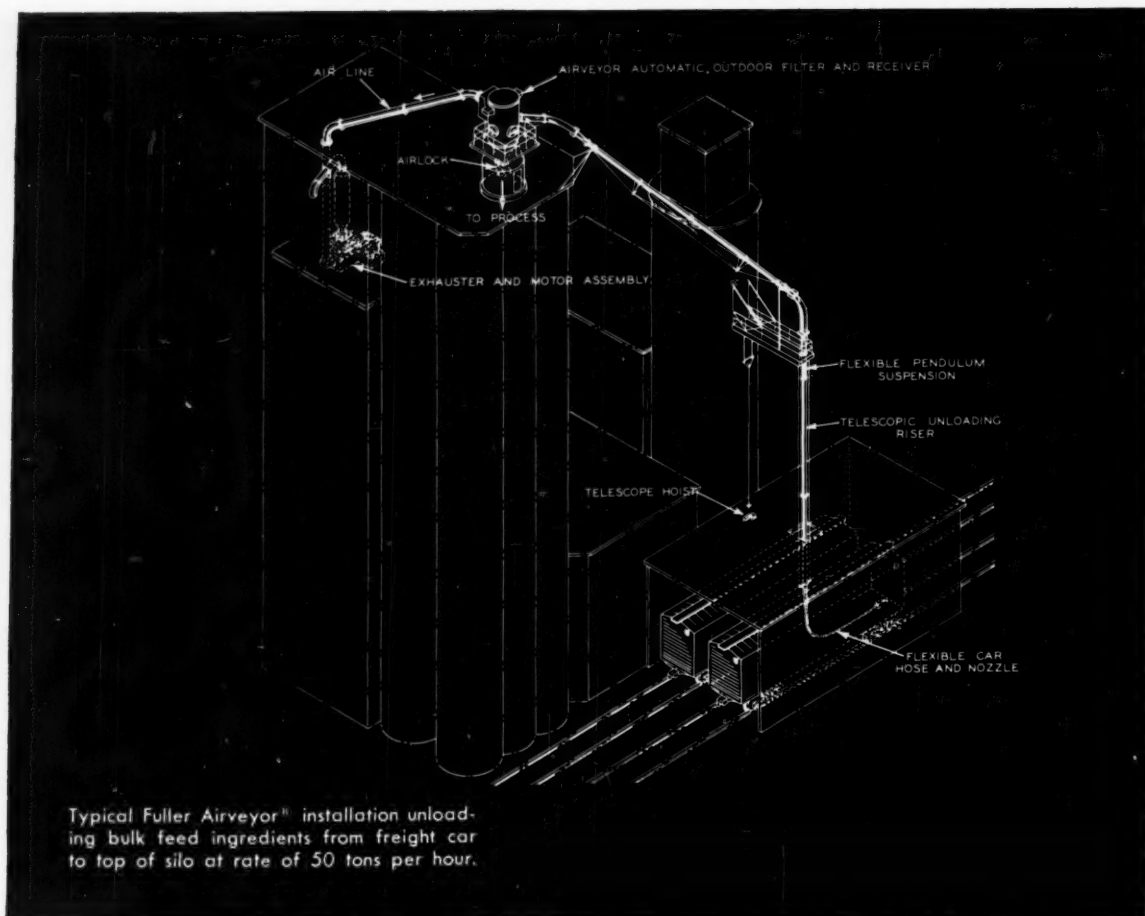
Stone & Webster assumes complete responsibility for the creation of an entire installation... or is available for consultation on special engineering problems. Call or write our nearest office for further information.



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How Fuller Pneumatic Bulk Materials Handling Can Help You Expand Plant Capacity

When plants processing dry, finely-divided bulk materials greatly expand production and bulk storage facilities, Fuller pneumatic equipment is most likely to take on the expanded materials handling job.

For example, a major Midwest feed company had been using a mechanical system to unload freight cars of barley, wheat, shorts, bran, dehydrated alfalfa and other feed ingredients. But, when the plant recently increased its number of storage bins from 10 to 40 and stepped-up deliveries of these ingredients a faster, more efficient unloading system was needed. The answer was a Fuller

Airveyor® vacuum system—operated by one man at a pushbutton control. This system conveys as much as 50 tons of bulk feed ingredients an hour. The Airveyor® pneumatic lines were installed easily. Sanitary sealed-in system seldom needs maintenance and is inherently self-cleaning.

Consider the low initial cost and many operating economies of Fuller pneumatic conveying systems when you plan to increase plant capacity. Write or phone outlining your problem. Fuller will gladly furnish additional information with appropriate recommendation.

1175
A-268



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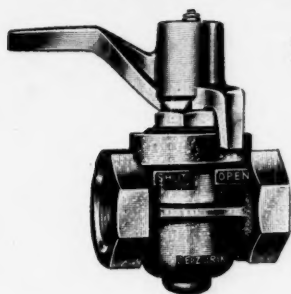
Certified Leak Rate*:

less than .01 micron cfh
thru the stem seal . . .
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seat leakage!

* on 3" DeZurik Valve

*...Here's a high
vacuum valve
you can
DEPEND on!*

1. Long Maintenance-Free Service Life



2. Extremely Low Leak Rate

3. Straight-Thru Flow for Low Impedance

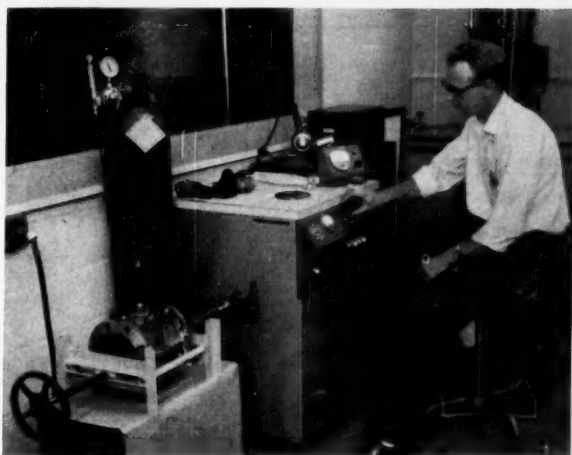
4. Low Initial Cost

Used on high vacuum, air release or throttling service, DeZurik Valves combine the unique advantages of eccentric action and resilient plug facing to provide the special requirements of high vacuum service.

Their simple, positive action assures longer service life with less maintenance.

On such vacuum services as solvent recovery, oil deodorizing, molecular distillation, vacuum fusion analysis and others, DeZurik Valves are the dependable, low cost answer.

DeZurik Valves for vacuum service are available in sizes from $\frac{1}{2}$ " to 20 and in manual or remote operated models. See the DeZurik representative near you, or write for details.



Each DeZurik high vacuum valve is tested before shipment. Tests are made with the most accurate equipment available, a Helium mass spectrometer type leak detector.

 **DeZURIK**
CORPORATION
SARTELL, MINNESOTA

How to beat the high cost of temperature control

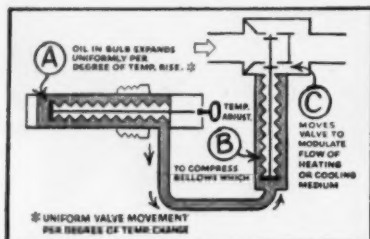
The practical approach to temperature control

By John W. Ritter, Test Engineer,
SARCO Company, Inc.

Precise temperature regulation is essential in many processing operations, not only for quality control, but for maintenance of output as well.

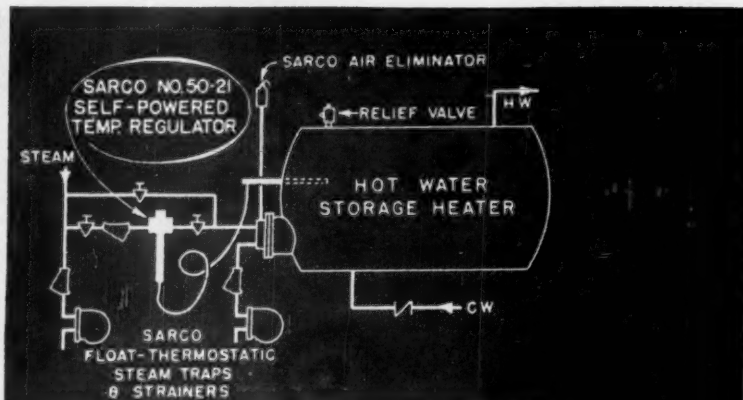
Manual temperature control is unsatisfactory because of the possibility of spoilage and loss of quality control which can result from irregular or indifferent hand regulation.

Automatic controls are available in a wide variety, including pneumatic, electronic, and self-powered. Pneumatic and electronic controls are relatively expensive to purchase and install, and may require frequent maintenance. However, in most applications, control requirements can be achieved very successfully by the use of relatively simple, economical Sarco Self-powered Regulators.



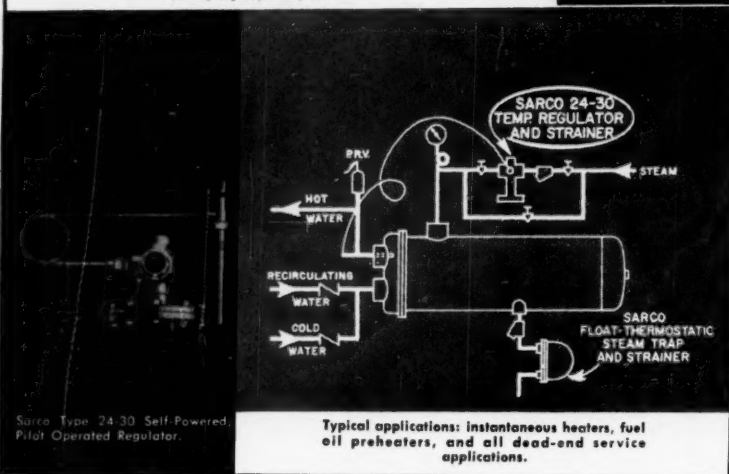
This drawing shows simplicity of operation of the Sarco 50-21 Temperature Regulator, which consists of a thermostat, capillary tubing, and a valve.

Sarco controls, like the 50-21 and the 24-30, have the required degree of sensitivity and dependability, combined with the ruggedness inherent in the sealed capillary tube construction. Because these Sarco controls do not depend on external power, such as electricity or compressed air, they have established long records of sustained, reliable operation. They are an economical and practical solution to the problem of maintaining continuous watchdog duty over processing temperatures.



Typical applications: hot water storage heaters, shell and tube heat exchangers, condensers, oil storage tanks, dryers, kilns, etc.

Sarco Type 50-21 Self Powered Regulator



Sarco Type 24-30 Self-Powered Pilot Operated Regulator

Typical applications: instantaneous heaters, fuel oil preheaters, and all dead-end service applications.

Self-powered automatic temperature regulators by SARCO...

have these 5 marked advantages: No compressed air or electrical wiring required. No delicate mechanisms to adjust or maintain. No packing glands to stick or require maintenance. No shut-down during power failure. No specialized maintenance required.

Sarco Self-Powered Controls are self-contained and can be installed by any pipe fitter. They are so reasonable in cost that you can afford Sarco automatic heating controls for every application in your plant. Write for 10-page Sarco Control Bulletin No. 620.

6346-B

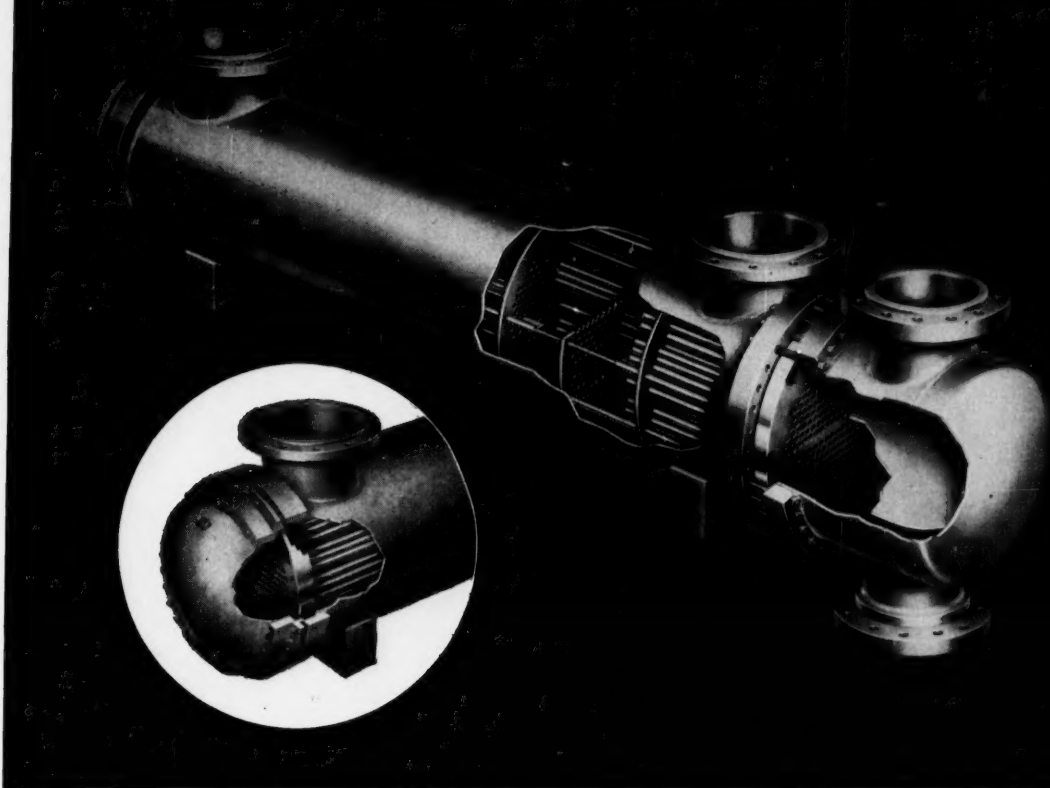
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STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

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Extreme flexibility predominates . . . in materials, sizes and arrangement of components, mounting position, tubeside passes, nozzle orientation. Your choice is virtually limitless in meeting a tremendous range of conditions.

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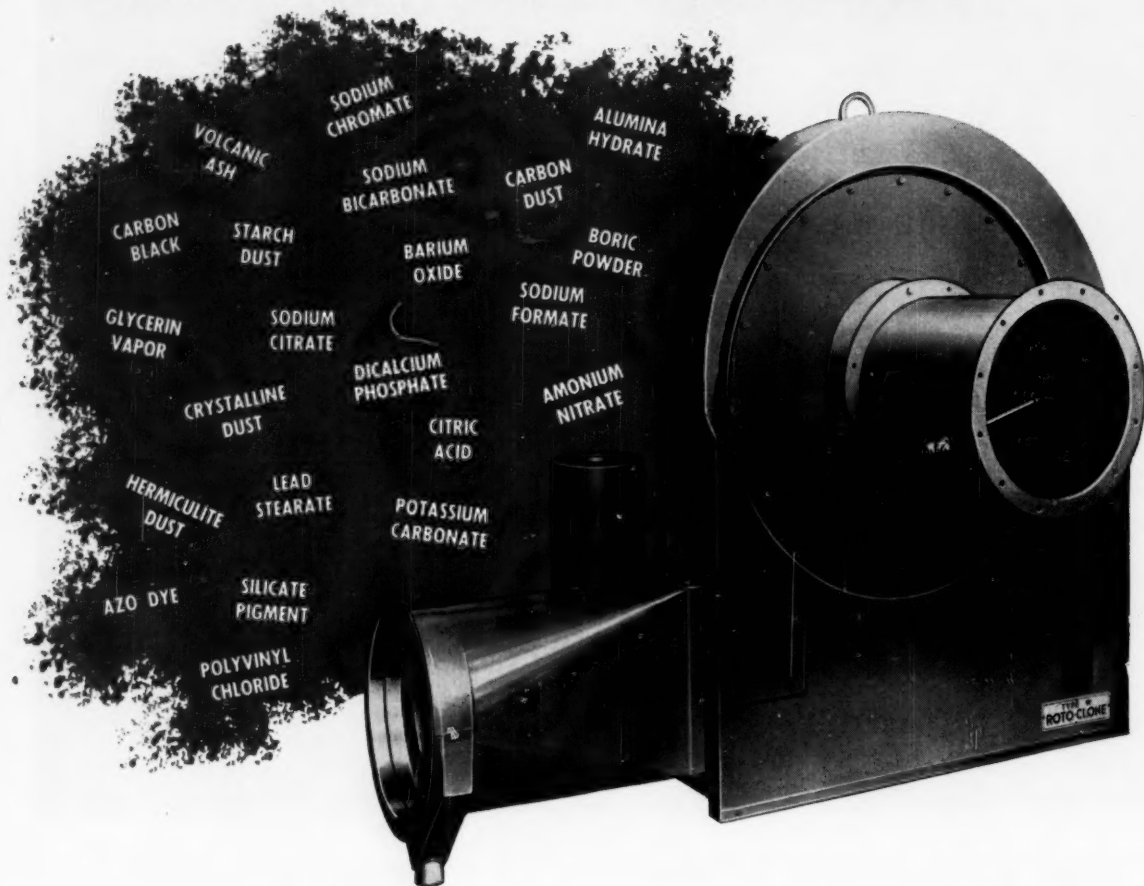
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Do you have a **DUST PROBLEM?**



AAF TYPE W ROTO-CLONE DOES MANY JOBS FOR CHEMICAL PROCESSORS

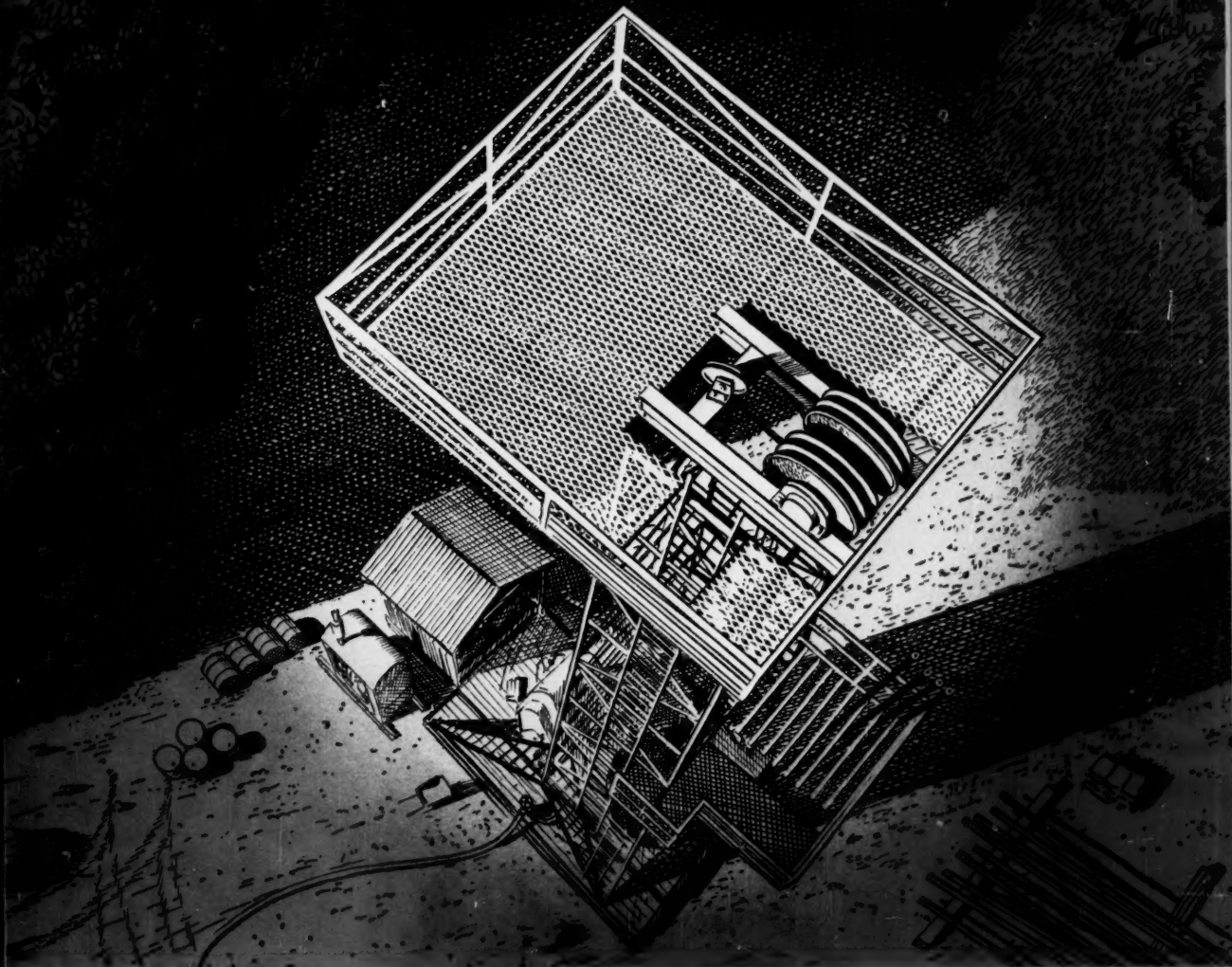
If your operations require collection of fine dust particles in moderate concentrations, you've got a job for the AAF Type W ROTO-CLONE.

The ingenious addition of water sprays extends the effectiveness of this dynamic precipitator to collection of the finest, lightest dust particles. The compact Type W ROTO-CLONE provides everything you need, except duct connections, in one complete shop-assembled package.

The Type W requires little maintenance, uses a minimum of water and maintains efficiency regardless of variation in air volume. It can be made of special metals or protected with most coatings at modest cost. For complete information, call your local American Air Filter representative or write direct for Bulletin 272B. Address: Mr. Robert Moore, American Air Filter Company, Inc., 326 Central Avenue, Louisville, Kentucky.



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BETTER AIR IS OUR BUSINESS



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A good, dependable water supply system is no better than its beginning. The best beginning is a Layne drilled water well. Layne is the largest water well drilling organization in the world with over 75 years experience. Trained crews operate over 500 drilling and service rigs throughout the country.

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QUANTITY of water, and Layne water treatment service to supply the exact QUALITY of water desired, are part of a complete job with undivided responsibility. But, that's not all. Layne maintenance and repair service wraps up the complete package. Your nearby Layne Company is as close as your telephone, so, call on Layne for a dependable water supply, right . . . from the top down, all backed by Layne Research.

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• **Quality Fine Grinding...**
20 Mesh To 400 Mesh...
Micron Sizes On Some
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EXCLUSIVE GEARLESS AND SPUR GEAR DRIVES

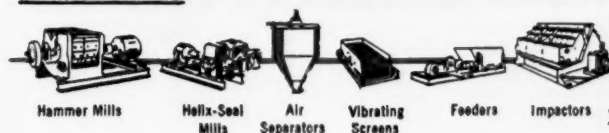
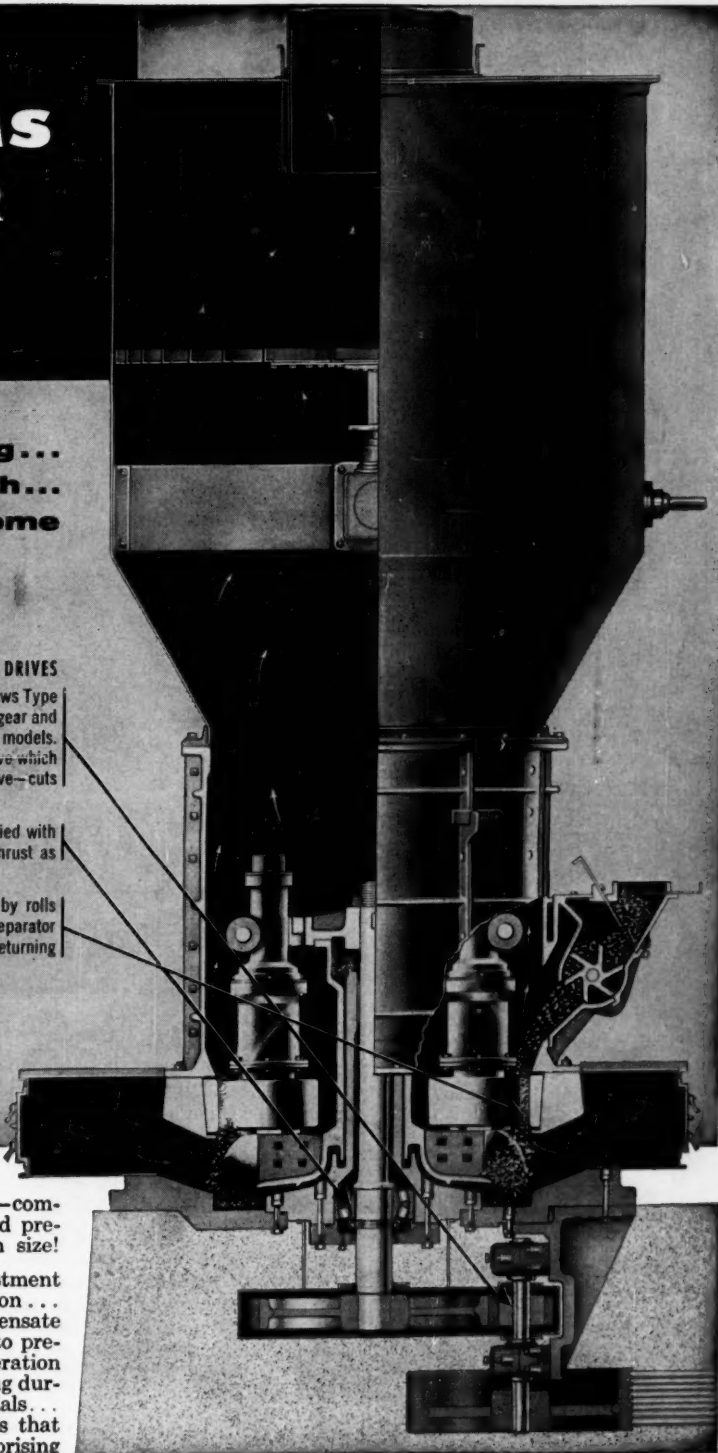
Another Williams advancement! Cutaway shows Type D Mill with Spinner Air Separator with spur gear and pinion drive used on Standard and larger models. Smaller sizes have simple gearless V-belt drive which is easier to maintain than bevel gear drive—cuts labor and downtime.

Bearing alignment of central shaft is simplified with only 2 bearings, the bottom one carrying thrust as well as radial load.

NOTE FLOW OF MATERIAL being ground by rolls rotating against bull ring, then air-swept to separator which discharges finished product while returning coarse tailings for regrinding.

From raw material to finished product—completely automatic grinding, blending and precision classifying to 20 mesh or micron size!

Self-adjusting feed rate... instant adjustment for sizing, even while mill is in motion... continuous automatic take-up to compensate for wear... constant rising air current to prevent build-up of fines and inefficient operation... automatically controlled hot-air drying during grinding of moisture-carrying materials... all are features of Williams Roller Mills that virtually guarantee increased output, surprising cost reductions and exceptionally high uniform quality. Get all the facts immediately... Write today for catalog.



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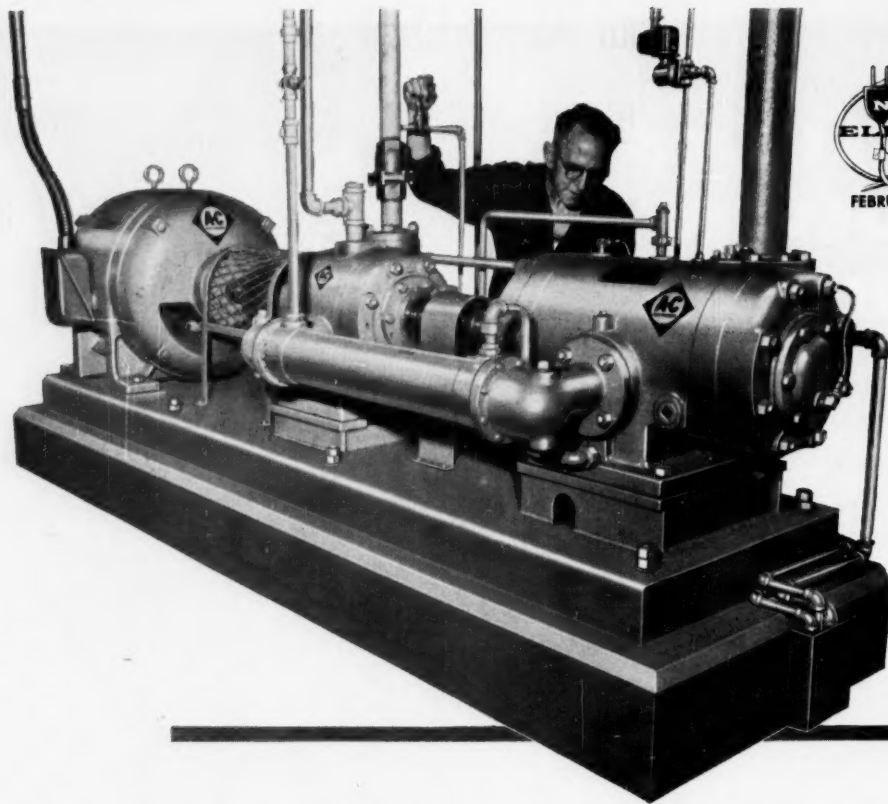
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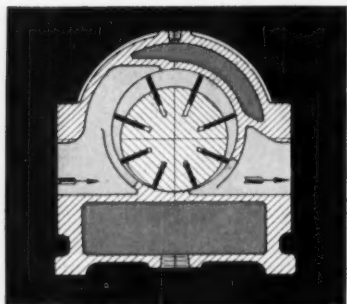




**NATIONAL
ELECTRICAL
WEEK**
FEBRUARY 8-14, 1959

Smooth operation—Prolonged efficiency

with **Ro-Flo** compressors for
plant air supply



Simple operation—centrifugal force holds blades against sidewall to form air chamber.

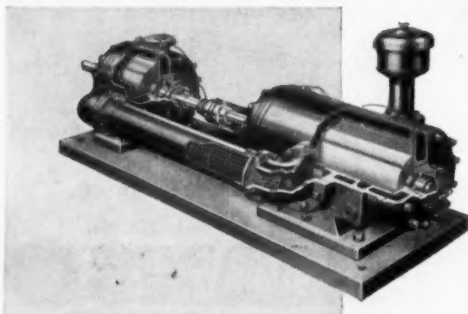
Rotary operation is smooth, vibrationless. Compare this to the pounding and shock inherent in reciprocating compressors.

That's why *Ro-Flo* compressors eliminate the cost of heavy foundations. A slab is enough. Smaller units are bolted to the floor. And "like-new" efficiency is maintained for years—because rotor blades compensate for wear automatically.

No pistons, valves or connecting rods to cause trouble. Only two wearing parts in the *Ro-Flo* compressor. All this means far less maintenance.

Two-stage units range from 250 to 1800 cfm, from 60 to 125 lb gauge. Single-stage units from 40 to 3000 cfm, up to 50 lb gauge. Ask your A-C man for descriptive literature, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

Ro-Flo is an Allis-Chalmers trademark.

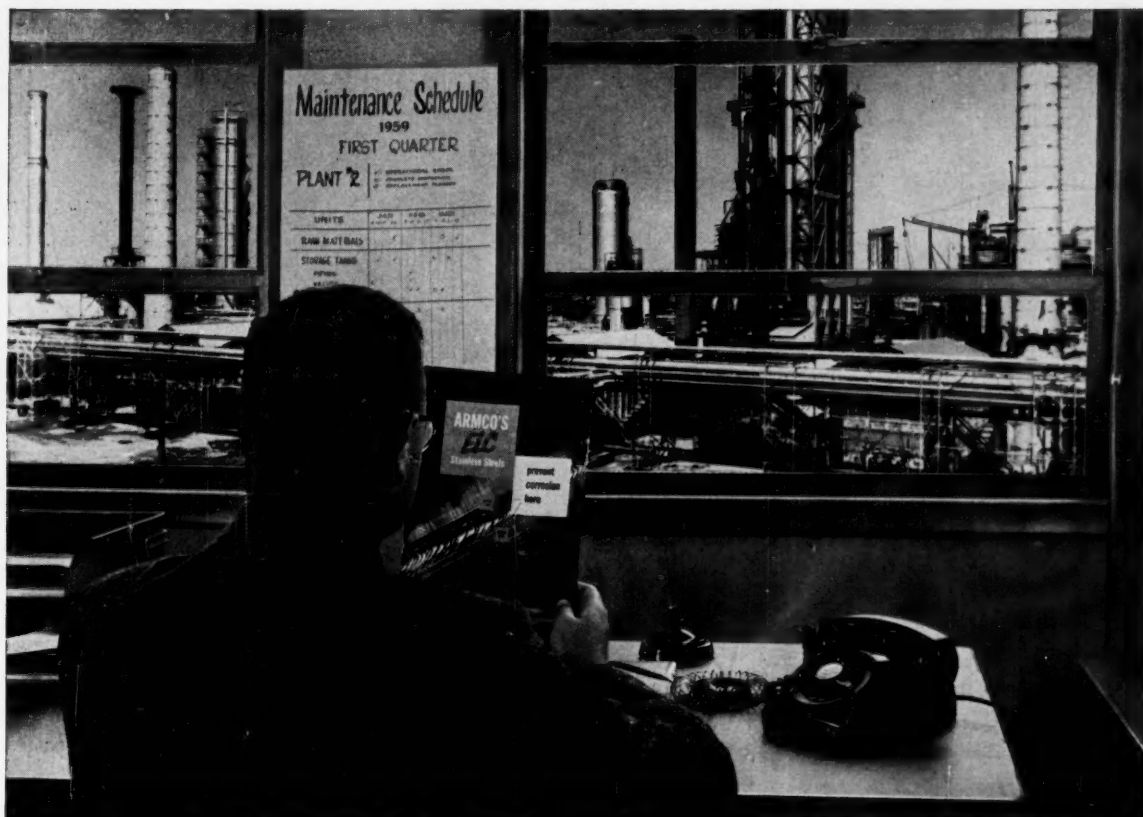


ALLIS-CHALMERS



A-5899

PLAN AHEAD with your Armco Stainless Steel Distributor to cut down-time and maintenance costs



Shut-down emergencies and routing maintenance can't be avoided. But you *can* reduce costly down-time and maintenance expense by planning ahead with your Armco Stainless Steel Distributor.

If he knows your requirements and you are familiar with his services and complete stocks of Armco Stainless Steels, you can save valuable time when repairs or alterations must be made *right now*. For example, he can shear, cut or saw stainless steels to your exact specifications.

In routine maintenance, too, your Armco Distributor's Stainless Steel Service Center can save you money. As close as your telephone, you have a complete inventory of standard and special Armco Stainless Steels. And the services of mill-trained engineers are available for assistance in grade selection and fabrication.

Make the most of the cost-cutting advantages that your Armco Stainless Steel Distributor offers you. Get in touch

with him today. If you don't know his address, just fill out and mail the coupon.

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Send information on Armco Stainless Steels to be used for

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8'-0" x 150'-0" Rotary Kiln in a portland cement plant.



12'-0" x 325'-0" Rotary Kiln in a chemical plant.



Shown above is a Traylor Kiln in a chemical processing plant where its efficiency and economy are demonstrated 24 hours a day. For precision-built and rugged machinery, call on Traylor Engineers today. Write for Bulletin No. 1115 for more on Traylor Kilns.

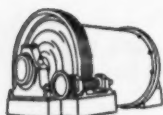
Traylor

TRAYLOR ENGINEERING & MFG. CO.

1120 MILL ST., ALLENTOWN, PA.

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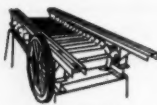
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NEW NO. 30 IS A LIGHT LOAD SPECIALIST

When the condensate load in your steam lines is *extra light*—this new Yarway $\frac{1}{2}$ " No. 30 Steam Trap is *exactly right*.

Specify it. You'll experience new *economy of operation* with the *tighter shut-off*. Operation is *quieter* due to lever action. *Maintenance is less*—because of the replaceable valve-seat assembly, only one moving part and stainless steel construction. Enjoy these special features plus all the regular advantages of famous Yarway Impulse Traps such as *quick heating, even temperatures, small size, good for all pressures, non-freezing*.

Over 1,250,000 Yarway Impulse Traps already sold; buy yours from one of 270 local Industrial Distributors.

YARNALL-WARING COMPANY
137 Mermaid Ave., Philadelphia 18, Pa.

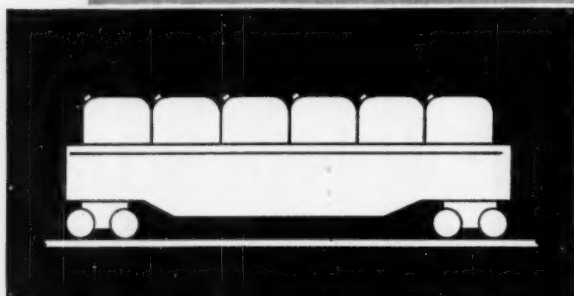
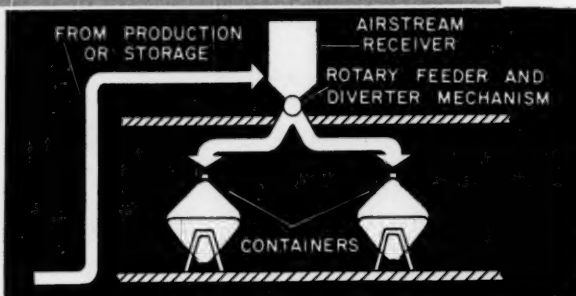
YARWAY *impulse steam traps*

a new concept in high-purity bulk handling!

Dracco Airstream conveyors + collapsible containers

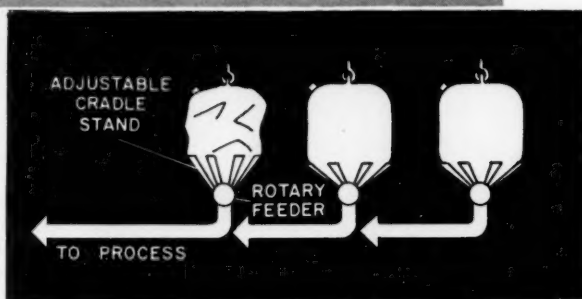
Shipping, receiving and storing high-purity materials in collapsible rubber containers has streamlined between-plant bulk handling. Now Dracco has adapted its advanced pneumatic conveying techniques to this important new method, providing a thrifty combination of automation and sanitation which maintains the highest standards of product purity.

Load containers directly from production or storage with Airstream Conveyor System. Handling is fast, automatic, completely enclosed. One-man supervision saves labor costs.



Ship via rail, truck or barge. Store outside until contents are needed. Containers are air-tight, weather-proof, reusable.

Unload and distribute material to process with Airstream Conveyor System. No loss or waste. Material is never exposed to moisture or contamination.



Automatic Airstream Conveyors can be teamed up with all types of portable containers to introduce faster, better handling at less cost. Write or call for further information.

DRACCO DIVISION OF FULLER CO.

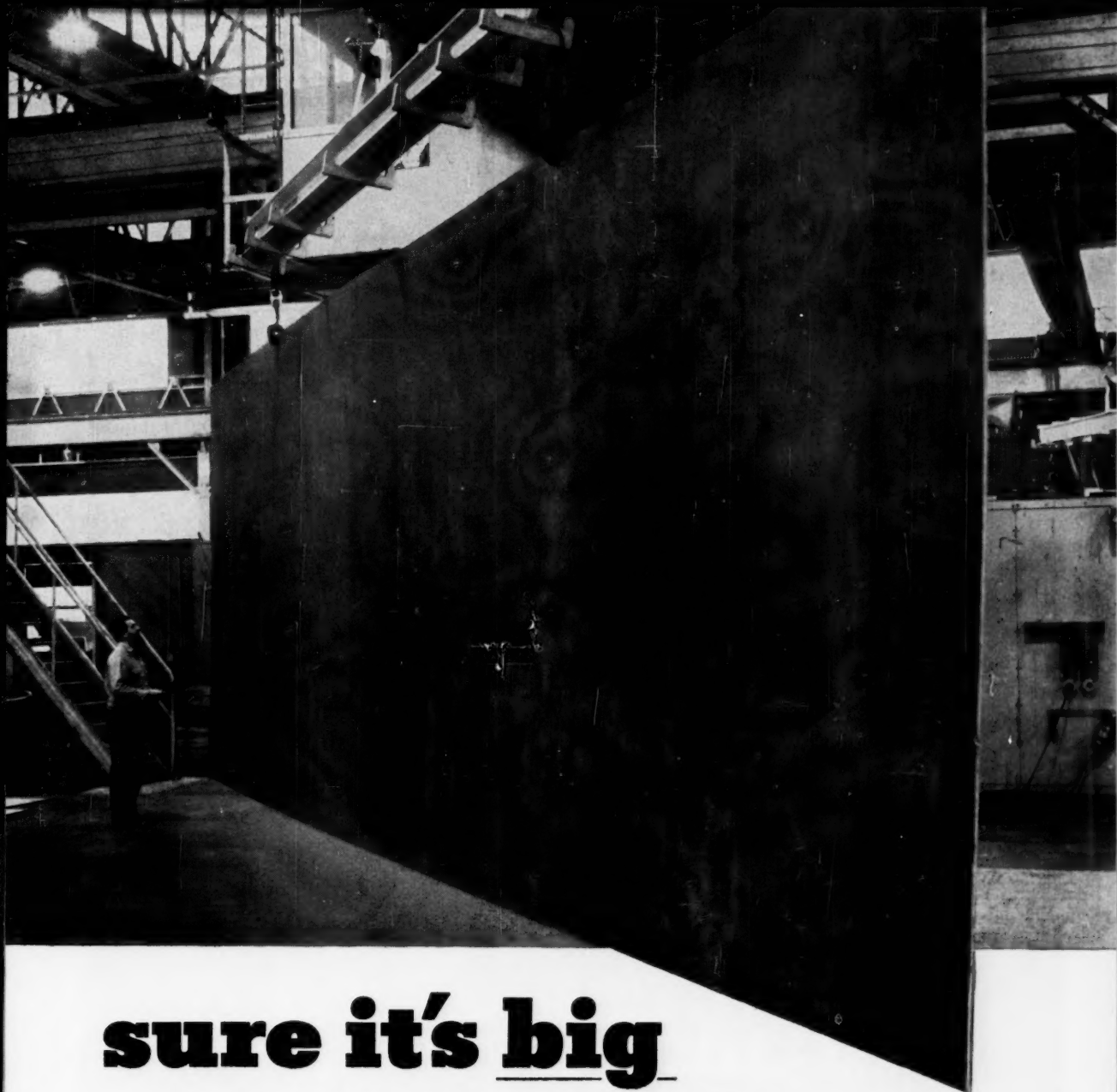
4040 East 116th Street • Cleveland 5, Ohio

Details on this new concept are presented in a new 12-page report "New Techniques for Automatic Bulk Handling", now available from Dracco.

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airstream conveyors
dust control equipment

(Pronounced Dray-co)



sure it's big

... but not particularly big or unusual

in Carlson's production of stainless steel plate

IT was normal, but not easy, for Carlson specialists to handle this big plate. Type 304-L stainless, it measured $\frac{1}{16}$ " x $131\frac{1}{2}$ " x $452\frac{9}{16}$ " and weighed an impressive 7923 pounds. And when this big one landed at the customer's receiving dock it was *exactly* what he wanted . . . *right* by chemical composition, *right* by physical standards, *right* to specification and *right* to size.

Whatever you need in stainless steel—big plates, small rings, formed or cut-to-shape items—will be

produced accurately and on time. Stainless steel is our *only* business, and we know it. That is why you can depend on Carlson to give you *what you want when you want it!* Your inquiry is invited.

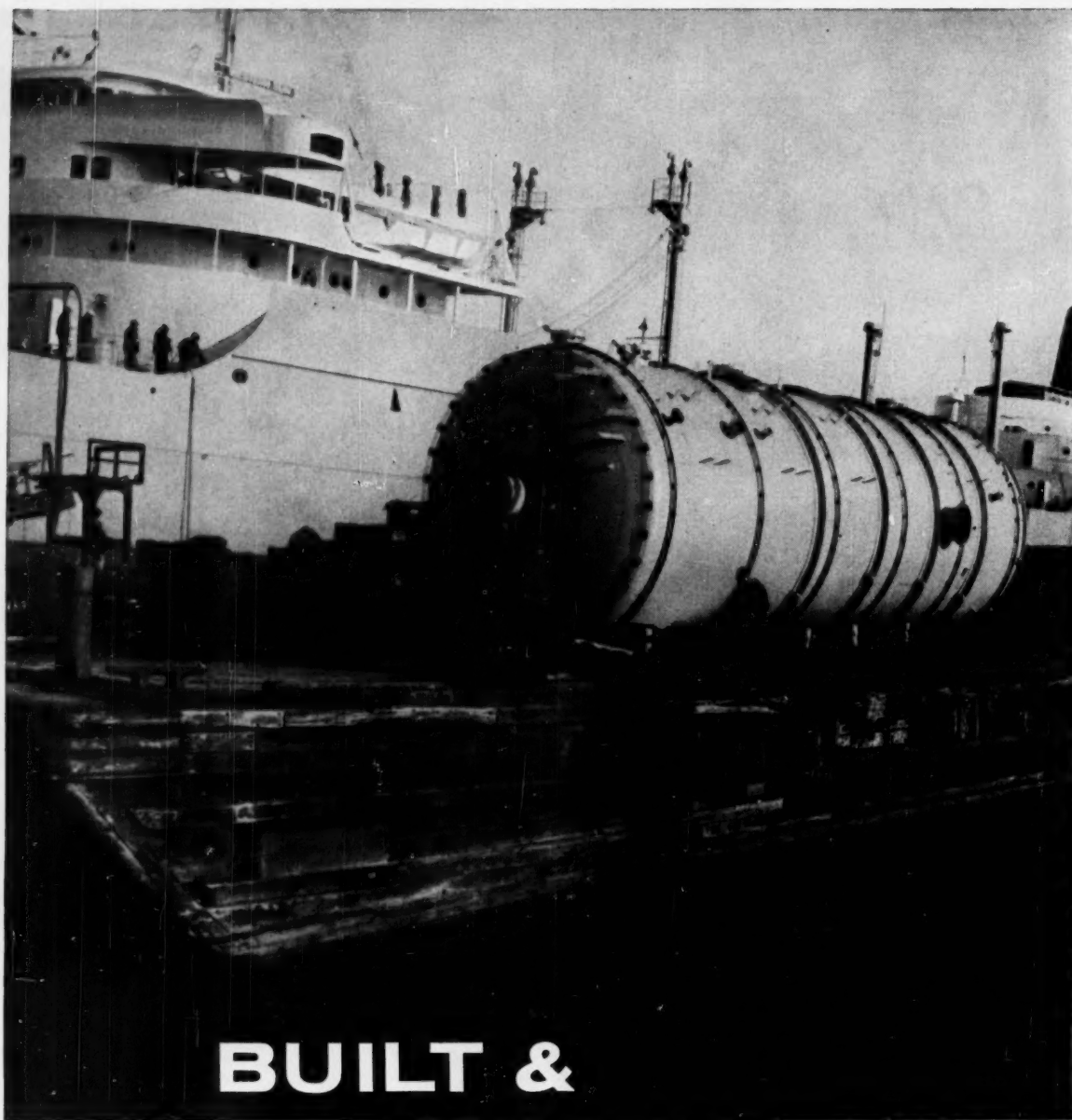
G.O. CARLSON Inc.

Stainless Steels Exclusively

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BUILT & SHIPPED... ON TIME

Today, modern oil refineries and chemical plants require more and more complicated pieces of fabricated equipment—too large to ship by rail or road. To meet this need, Sun Ship specializes in building and shipping large carbon or alloy steel units by water (inland, coastal or overseas)...directly from our plant.

SUN SHIP
BUILDING & DRY DOCK CO.
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in Savings!

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CONTROLLED-VOLUME CHEMICAL PUMP

The moment your new Pulsafeeder is put into operation, you're on the way to real savings . . . savings that can eventually result in the Pulsafeeder paying for itself.

Lapp Pulsafeeder, the chemical pump with *no stuffing box*, is a piston-diaphragm pump providing *positive displacement* by a piston pumping a hydraulic medium working against a diaphragm. The diaphragm isolates the chemical being pumped from the working pump parts . . . eliminates need of stuffing box or running seal . . . prevents corrosion. Maintenance costs are reduced to next to nothing—there are practically no repairs or replacement of parts with a Pulsafeeder. You'll save, too, by elimination of product loss due to leakage or contamination. In the long run, Pulsafeeder is the safest, surest and lowest cost controlled-volume chemical pump. To prove our stand, we'll be happy to quote actual maintenance costs taken from recorded case histories.

WRITE FOR BULLETIN 440 with typical applications, flow charts, description and specification of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 3606 Poplar St., Le Roy, N. Y.

NO LEAKAGE

NO CONTAMINATION

NO PRIME LOSS

NO STUFFING BOX

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IN PRESSURE OR VACUUM DISTILLATION METAL PALL RINGS PROVIDE MAXIMUM SEPARATION—MAXIMUM CAPACITY

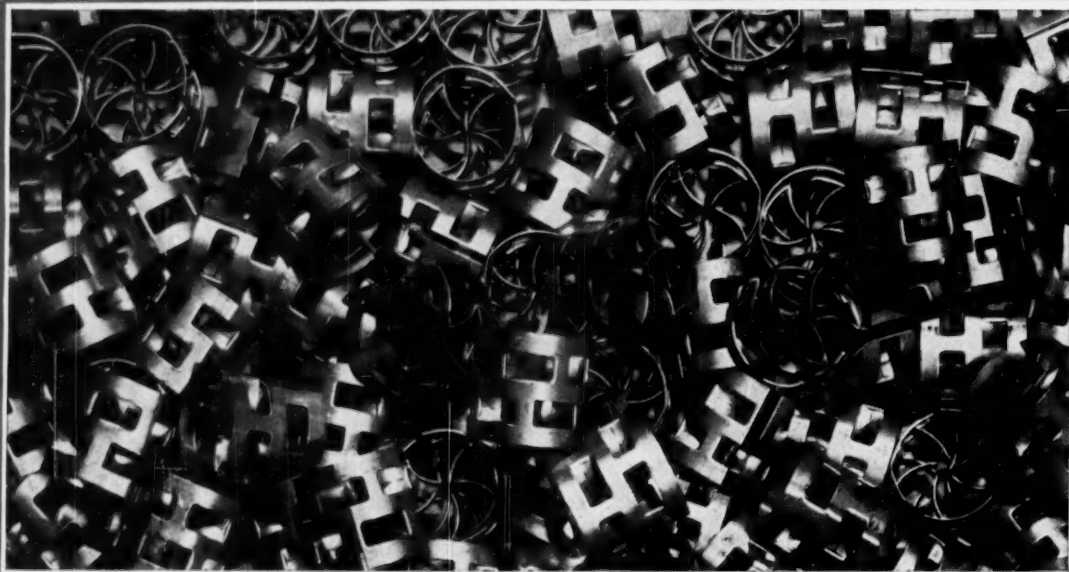
...with a minimum size shell

The superiority of metal Pall Rings is nowhere more clearly established than in distillation operations. Here two characteristic advantages of the Pall Ring come into play: (1) extremely low pressure drop, and (2) exceptional internal distribution at the low liquid rates employed in distillation.

In bubble cap towers or distillation columns packed with raschig rings the higher pressure drops necessitate higher pressures and higher boiler temperatures. Not infrequently the temperature required is so high as to invite product break down.

Not only can lower pressures and lower boiler temperatures be employed when the column is packed with metal Pall Rings but the fractionating efficiency of the column can be improved as much as 25% to 40%. In new construction the higher efficiency of the metal Pall Ring permits substantially smaller shells to be employed.

Metal Pall Rings are now being made in the $\frac{3}{8}$ ", 1", 1½" and 2" sizes from carbon steel, the 18-8 series of stainless steels, monel, inconel, titanium, aluminum and copper.



The metal Pall Ring is similar to the raschig ring in that height and diameter are equal. In the raschig ring the interior wall is mostly inactive providing little or no active contact between phases. In the metal Pall Ring, sections of the wall are stamped and bent inward, thus making the inner wall an active, working surface. Pressure drop is less than half that of raschig rings, resulting in a much greater capacity per unit of tower area.

Write today for engineering
data on metal Pall Rings.


U. S. STONEWARE
AKRON 9, OHIO

224-F

DEVELOPMENTS ...

FEBRUARY 9, 1959

Chementator

C. H. CHILTON

New cellulosic fiber is now in testing stage, reports American Viscose. Known simply as "Fiber 40," product is described as unlike any fiber heretofore manufactured.

National Distillers is working on a low-pressure polymerization process which could produce any desired polyolefin from polyethylene up. NDC Chairman Bierwirth visualizes a plant which could be changed from one polymer to another by pushing a few buttons.

West Virginia Pulp & Paper has pilot equipment for making a paper which will stretch in all directions. Original Clupak process, now commercial, produces paper stretchable in only one direction. Capacity for Clupak is being stepped up by addition of a second "stretching" machine at Charleston, S. C.

Methanol muddle: Who's responsible?

Amidst charges and countercharges of fraud, breach of contract and technical incompetence, differences between Monsanto, Heyden Newport and M. W. Kellogg over building of a \$6.5-million methanol plant at Texas City erupted into stinging court actions last month.

In New York, Kellogg asked the State Supreme Court to compel Monsanto to submit these differences to arbitration in accordance with the original contract signed by the three parties in June 1953. Simultaneously, Kellogg filed an application with American Arbitration Assn. for arbitration of its claims upon Monsanto for unpaid bills amounting to \$652,000.

In Wilmington, Del., on the same day, Monsanto and Heyden Newport (a) asked the Court of Chancery to issue an immediate injunction blocking Kellogg's arbitration moves and (b) filed suit in Delaware Superior Court asking for award of damages totaling some \$9.5 million. Chancellor Marvel denied the request for an immediate injunction but set a hearing date for late January so that Kellogg could defend its actions.

Original objective of the plant around which this dispute centers was to convert off-gas from Monsanto's acetylene-from-methane plant into methanol. A portion of the output was earmarked for use by Heyden in its own manufacturing operations. Acetylene offgas was to be processed in a German Linde low-temperature rectification unit. This would yield the synthesis gas feed stream for a methanol unit based on know-how licensed from Imperial Chemical Industries.*

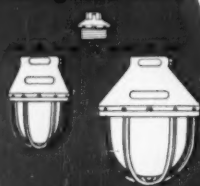
Kellogg estimated a completion date of Nov. 1, 1954, and guaranteed a five-day demonstration of 78,800 gal./day capacity when operating on a raw gas of specified quality and adequate quantity. Plagued by a succession of delays (each party blames the other), Kellogg

*Another plant with a similar objective was recently built by Foster Wheeler for Rohm & Haas at Houston. Offgas from an acetylene plant is converted into methanol synthesis gas via a partial oxidation unit, rather than via low-temperature rectification. Although plant is running OK now, process difficulties have required fairly expensive changes. However, the two parties were able to reach a satisfactory financial settlement.

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NEW
Anti-Vibration
Guard!**

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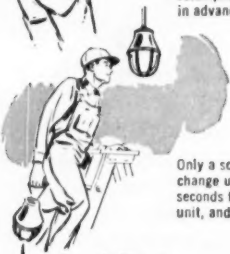


Identical diameter "A" on
Dome Assemblies permit quick
interchange of fixtures with
different wattages (from
60 Watt to 500 Watt)

**58 Second
Relamping**



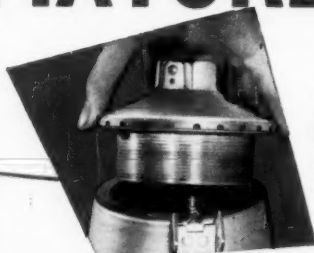
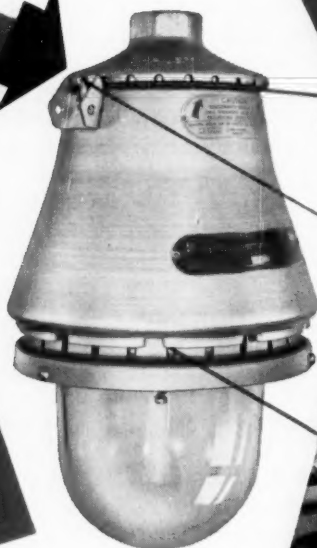
Series "AA-51" stand-by units are
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relamping...with handles attached
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change units...and only 58
seconds to climb ladder, change
unit, and descend.



Cleaning fixtures, changing
burned-out lamps, can be
done safely at bench...
preventing costly
shutdowns.



Close-up showing canopy,
extra-safe multiple "AA-51"
contact threads, and anti-vibration
guard with V-shaped metal prong
before engaging canopy
notches.



Canopy is securely locked
against vibration disturbance
by positive engagement of
V-shaped metal prong in
tightly sealed canopy
notch. This anti-vibration
guard may be quickly re-
leased by hand pressure for
maintenance.

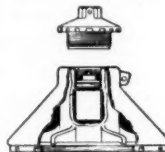


Similar in action to canopy guard,
this close-up shows anti-vibration
guard locking globe ring to dome
unit assembly. Metal prong in
dome unit is securely engaged by
notched globe ring to prevent
accidental loosening. This anti-
vibration guard also may be quickly
released by hand pressure for
maintenance.

*The fixture with "all" the features now
sets even greater standards of efficiency and safety!*

APPLETON's new anti-vibration guard on all "AA-51" vented explosion-proof fixtures assures users of positive protection against spark caused mishaps due to vibration conditions. Coupled with multi-thread safety design where a "flame-tight" contact chamber permits servicing *even with the current on*, this new anti-vibration guard demonstrates APPLETON's continuing quality research program to bring you the finest in electrical products. Check these other features for proof of "AA-51" design leadership and adaptability for your requirements. Write for complete information today.

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Porous metal interior and
specially designed hood
dissipate heat evenly and
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missed completion date by about four months (March 1955). Two more years dragged by (June 1957) before Kellogg could claim that guaranteed performance had been successfully demonstrated.

Monsanto-Heyden claim that Kellogg misrepresented its technical know-how, was "grossly negligent" on 33 specific counts and that the plant even today does not conform to contract specifications. "These charges are preposterous," retorts Kellogg President Warren Smith.

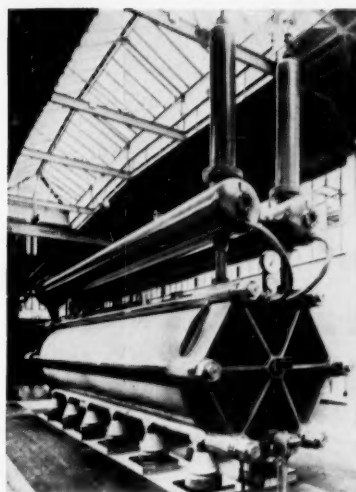
Monsanto-Heyden's attempt to avoid arbitration involves a neat maneuver that has engineering and legal circles buzzing. Because Kellogg has failed to fulfill its obligations under the contract, says Monsanto-Heyden, we are excused from our contractual obligations, including the arbitration clause. If upheld, this move might render meaningless similar arbitration clauses which are part of almost every such contract.

Why are Monsanto-Heyden disinclined to arbitrate? Kellogg explains that the kind of damages Monsanto-Heyden seek are outside Kellogg's contractual liabilities. Not only do they claim damages for lost or uneconomic methanol production, Heyden also claims that troubles with the methanol plant depressed the market value of its stock so that its acquisition of Newport Chemical Co. two years ago cost an increased number of shares of Heyden stock; Heyden claims damages of \$2 million on this point alone.

Regardless of the specific legal issues involved, this case focuses attention on a fundamental problem of engineering practice. Most professional engineers are averse to competitive price bidding and attendant guarantees for engineering services. Yet the economic facts of life in the process industries (especially in petroleum refining) dictate otherwise.

Engineering contractors agree to these guarantees reluctantly and raise their prices, if possible, to cover the added risks. However, they almost always insist that their liabilities be limited to (a) labor and materials required for plant alterations to meet the guarantee and (b) a specified penalty for delays beyond an agreed-upon date.

If Monsanto and Heyden get any substantial portion of the \$9.5 million damages they seek, there may be some pretty drastic changes in the way engineering contractors do business in the future.



Pressure slashes electrolysis power

Lurgi's high-pressure water-electrolysis cell (*Chem. Eng.*, Oct. 6, 1958, p. 54) is now bidding for world-wide markets. With one unit successfully running in a large Swiss ammonia plant, the German firm has licensed Winfield Equipment Co., Cleveland, to handle sales in the U. S. and Canada.

The Lurgi cell operates under a pressure of 30 atm., producing high-purity hydrogen and oxygen which, for many uses, require no further compression. In addition, electrolysis under pressure takes 20% less power because of lower voltage drop. Other advantages: 50% savings in floor space, low capital investment, minimum operating attention.

Frank Haas, Winfield's vice president, hopes to sell Lurgi's cell design to American engineers who have shied away from bipolar (filter-press type) cells in the past. Selling points: Diaphragms are joined by Teflon rather than asbestos; a self-contained pump-filter circulation system prevents localized electrolyte buildup.

Competing processes join hands

Solvent extraction and ion exchange—usually cast in opposing roles in the uranium industry—have recently joined hands to lick a specific problem in the uranium mill of Mines Development, Inc., Edgemont, S. D.

This 400-ton/day mill has tacked a solvent extraction flowsheet onto a resin-in-pulp ion exchange process. The SX unit recovers ura-

(Continued on page 60)



New H-30 Merco Centrifuge, with increased speed and capacity, in operation at Argo, Ill. plant of Corn Products Refining Co.

NOW...

increased capacity in NEW MERCO CENTRIFUGE for nozzle bowl applications

Rotor speeds up to 3300 rpm and capacities up to 600 gpm are now possible with the new, improved H-30 Merco Centrifuge. At the same time, power requirements per gallon of feed have been substantially reduced.

In the first two installations, this new unit produced comparable removals at nearly double the capacity of previous models . . . and showed *no increases* in total power consumption.

This new operating efficiency is a result of improvements in rotor design, which provides greater disc area. Feed passages have been enlarged to accommodate increased flow.

The new Merco H-30 Centrifuge is particularly useful for clarification and thickening of slurries which contain fine solids (0.5 micron) over a wide range of feed solids concentrations (.02% and up). It is now available with a 30" stainless steel rotor

and bronze or stainless steel housing. In addition to its new large capacity and higher speeds, it contains these standard Merco benefits:

- The unique return flow principle that permits concentrating, washing, clarifying, classifying and recovery of soluble values at pressures up to 150 psi.
- No nozzle clogging or solids build-up in the unit.
- Overhead drive eliminates need for submerged bearing.
- Hydraulic hoist is built in to simplify inspection and maintenance.

If yours is a process that needs a large capacity centrifuge, there is a place for the Merco H-30 in your plant. For further information, write to Dorr-Oliver Incorporated, Stamford, Connecticut.

Merco—Reg. T.M. Pat. Off.



nium from RIP eluate. This technique, known as the Eluex process, was first worked out by National Lead Co. at AEC's Raw Materials Development Laboratory.

Advantage of Eluex over solvent extraction alone is that it can handle an unfiltered acid-leached pulp. But what's wrong with straight ion exchange?

MDI was using sulfuric acid to leach pulped ore. After contacting the pulp with the resin (adsorption cycle), the barren acid slime was neutralized and settled, and the clear overflow was discarded into the Cheyenne River. This acid solution could not be recycled to the mill because it contained enough nitrate to interfere with the adsorption step (nitrate came from the acidified sodium nitrate used in the elution step of the RIP circuit).

Yet management wanted to recycle tailings water because (a) water was in short supply, (b) neutralization was costly and (c) nitrate and radium contents of waste, even though minute, were potential pollution hazards.

At the Edgemont mill, loaded ion exchange resin is now eluted with 8.5% H_2SO_4 instead of a nitrate solution. Elimination of nitrate permits recycle of tailings water.

But this advantage would mean little if the strongly acid eluate had to be neutralized in order to precipitate the diuranate yellow cake with MgO . The Eluex process, therefore, provides for solvent extraction of the eluate with di-2-ethyl hexyl phosphoric acid and tributyl phosphate in kerosene. Final uranium recovery follows stripping of the extract with 10% soda ash solution.

An added bonus: MDI formerly had trouble meeting the minimum 75% U_3O_8 specification for yellow cake. The RIP-SX combination now yields yellow cake well over 80%.

New nuclear grades of graphite

Impervious graphite suitable for use at high temperatures is high on the want lists of nuclear reactor designers.

Rising to meet this demand, National Carbon Co. in the U. S. and British General Electric Co. in England have both announced the development of impermeable graphite products. Typical product offered by National Carbon has a permeability to gas flow only 1/750,000 that of ordinary graphite.

Plans for a helium-cooled reactor, recently submitted by Philadelphia Electric and Gen-

eral Dynamics to AEC, call for eventual use of a core in which the reactor fuel is canned in graphite. Compared with stainless steel cladding, use of graphite would raise permissible operating temperature from 1,050 to 1,400 F., boosting reactor capacity by one-third.

But ordinary graphite is too permeable to gases. And the conventional resin-impregnated impervious graphite used in chemical equipment is good only at relatively low temperatures.

Low absorptivity of liquids in graphite is also important to nuclear engineers concerned with liquid-metal and fused-salt fuels.

National Carbon points to three significant advances in technology which have led to impervious graphite:

- Use of different raw materials, including graphites and blacks of various types, in the basic mix.

- Use of new carbonaceous impregnants whose lower viscosities and improved wetting tendencies do a better job of blocking the pores of normal graphite.

- Use of new forming techniques, including, in particular, pressure baking, in which heat is applied by passing an electric current through the carbon in the mold while under pressure.

Where We Get Our Energy

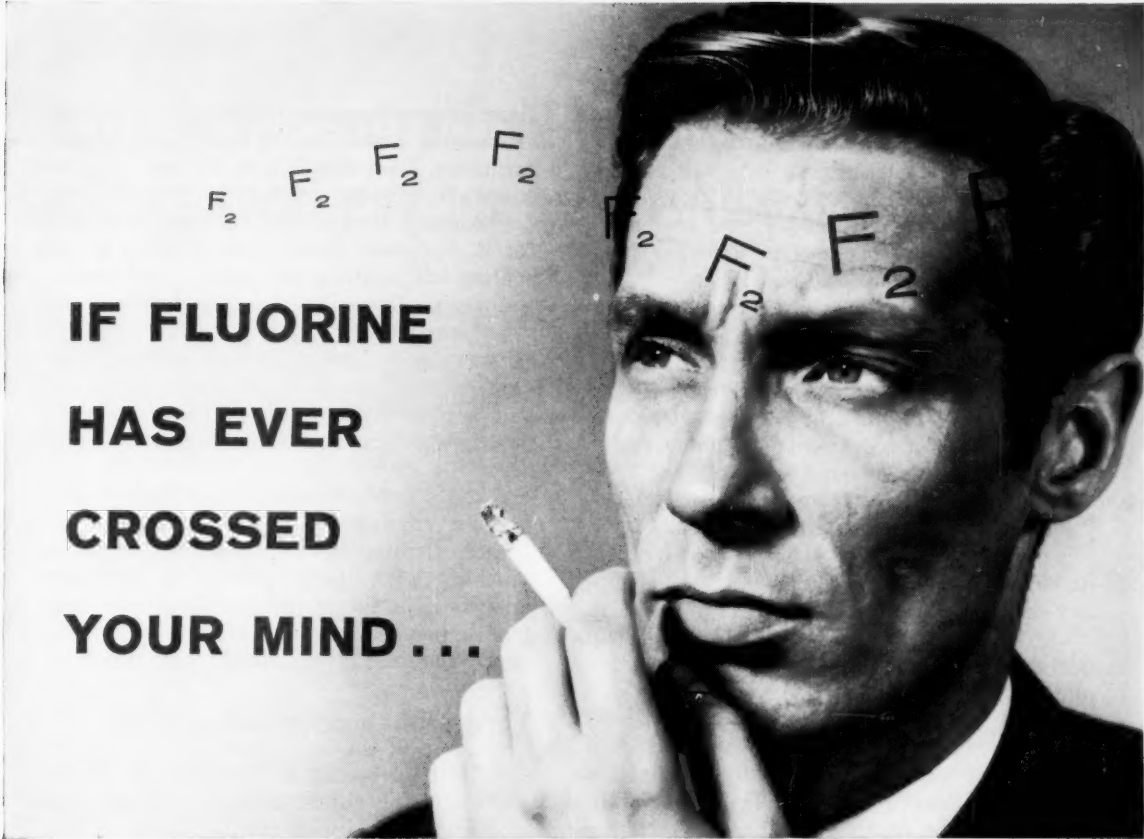
	1955		1975	
	% of Total	Relative Rank	% of Total	Relative Rank
Crude oil.....	39.6	1	39.5	1
Coal.....	28.2	2	24.9	3
Natural gas.....	25.2	3	28.5	2
Hydropower.....	3.9	4	3.1	5
Natural gas liquids.....	3.1	5	4.0	4

Estimates exclude possible place of nuclear energy in the total.

Shifting patterns in energy supply

Natural gas will provide a larger share of U. S. energy needs in 1975 than will coal. Thus predicts Resources for the Future, Inc., a nonprofit research organization.

Over the period 1955-1975, energy input to the U. S. economy will increase by 85%, says RFF. Use of natural gas will go up 100%; coal will go up only 70%, thus falling to third place in our energy picture. Oil will maintain its leading position with a growth rate just



**IF FLUORINE
HAS EVER
CROSSED
YOUR MIND...**

Now's the time to try it!

Time was when the thought of using elemental fluorine would be dismissed quickly. Both handling and availability presented major problems. But tremendous progress has been made in both these areas. And today, *if you've ever thought about using fluorine, now's the time to investigate!*

As the leading producer of fluorine, General Chemical has played a major part in these developments. General developed the first and only practical method for shipping fluorine as a liquid in bulk—making it

available in commercial quantities for the first time... making fluorine easier and more economical to use, handle and store. General also provides a convenient source of supply for fluorine gas in cylinders. And, to enable laboratory researchers to work with fluorine more safely and more easily, General has developed and tested a reliable new system for handling fluorine in the laboratory. A comprehensive, illustrated data sheet on this development is available, complete with schematic diagrams and directions.

As a result of these significant advances, you can now experiment with fluorine in the laboratory more conveniently and at minimal risk. If fluorine offers profitable avenues of investigation or commercial application, and you need elemental fluorine in large quantities, General Chemical is ready to meet your requirements.

For further information, just write or phone. Ask for our comprehensive technical bulletin, "Fluorine," or "Handling Elemental Fluorine in the Lab."

First in fluorine chemistry



GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

about equal to that of total energy consumption.

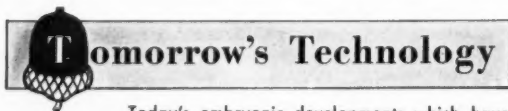
Although coal's growth rate will lag behind oil and gas, 70% increase in 20 years is a much brighter prospect for coal producers than the absolute declines in tonnages they experienced between 1920 and 1955.

Delayed coking skirts sulfur rule

Additional delayed coking capacity to consume more high-sulfur residual fuel oil is General Petroleum's answer to Los Angeles County's recently adopted Rule 62.

This new rule, which forbids burning of fuel having a sulfur content greater than 0.5% during the smog season (*Chementator*, Dec. 15, p. 65), will aggravate today's unbalanced supply-demand picture for petroleum products in California. Residual fuel is already in long supply, and Rule 62 won't help the situation any.

GP, a subsidiary of Socony Mobil, will install a fourth coker at Torrance with a capacity of 9,300 bbl./day, lifting total coking capacity to 35,000 bbl./day. The liquid products of coking (gas oil and gasoline) can be readily hydrogenated to remove their sulfur contents. No economical process is available today for desulfurizing resid; certain components, notably asphaltene, foul conventional desulfurization catalysts.



Today's embryonic developments which have special significance for chemical engineers

Keep close tabs on water quality

Industrial plants on the Ohio and other river systems may some day rely on continuous automatic monitors to bring quality of incoming river water within the plant control loop.

Not having suitable instrumentation available today, most plants have no idea how water quality varies from minute to minute or hour to hour, nor how such variations affect their operations.

But with a new system now under development by the Ohio River Valley Water Sanitation Commission, plants may get up-to-the-minute data on such water-quality variables as chlorides, phenol, turbidity, hardness, pH and oxygen-reduction potential. Then, for the first

time, plant engineers will be able to tell how changes in water quality affect process performance. Next step will be to exert dynamic control over water quality.

As envisioned by Orsanco Executive Director E. J. Cleary, robot stations along a river system will continuously sample and analyze the water. Resultant data could travel over leased lines to individual plants. Or, where a central control agency such as Orsanco exists, data can flow into headquarters for processing and action within minutes. And source of quality upset can be pinpointed to avoid recurrence.

Right now, Orsanco's W. L. Klein is proving out continuous analyzers mounted in a trailer set up at the Cincinnati Water Works. Working with three makers of continuous analyzers, Klein is seeking long-term untended performance and reliability not commonly required of industrial installations.

Vortex tube aims at cool markets

That intriguing refrigeration device, the vortex tube, is threatening to burst the bonds of the laboratory and make a place for itself in the world of industry.

AiResearch Mfg. Div. of the Garrett Corp., Los Angeles, has engineered a prototype commercial vortex tube which was featured in full-page national advertising last month. But AiResearch tells *CE* that it is not yet ready to market commercial models.

In operation of a vortex tube, compressed air is admitted tangentially at a point along the length of an open tube. Cold air emerges from one end of the tube, warm air from the other. As a cooling device, the vortex tube would be useful where freedom from moving parts and lubrication is necessary, such as cooling of parts of a nuclear reactor or cooling electronic equipment in isolated locations.

Thermoelectric cooling is another idea itching to get out of the lab. In this process, flow of an electric current produces "cold" at one junction of dissimilar conductors and rejects heat at another junction.

Admitting that vortex and thermoelectric cooling are less efficient than ordinary refrigeration cycles, AiResearch nonetheless sees considerable promise for both these unconventional devices.

For more on DEVELOPMENTS.....64

Here's how centralized lubrication savings soon pay for a Farval system

FARVAL—
Studies in
Centralized
Lubrication
No. 200



● Interested in a system that produces savings to pay for itself in a few months? And protects your investment in expensive equipment for ten, twenty, or even thirty years or more?

If so, you'll want this new Farval Bulletin 101. It illustrates and describes the application of Farval Centralized Lubrication Systems to a dozen types of equipment—draglines, shovels, crushers, mills, cranes, conveyors and other machinery used in the non-metallic producing and processing industries.

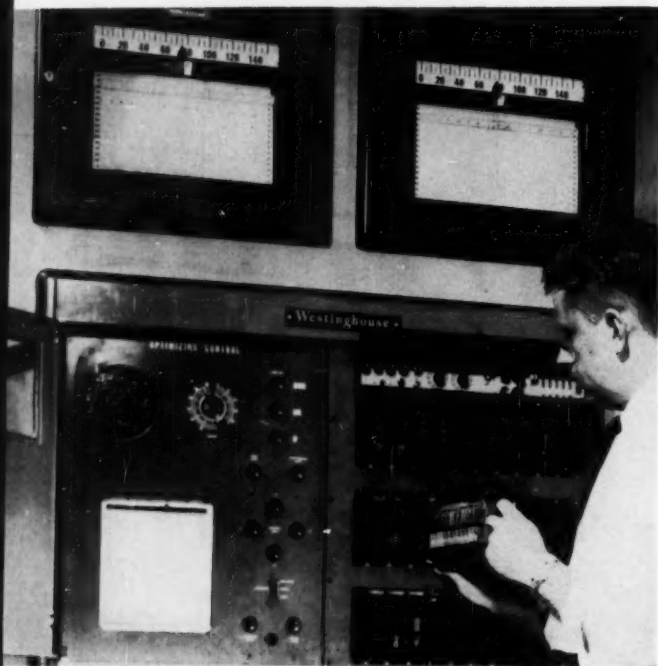
Millions of industrial bearings are protected by Farval. Thousands of new systems go in each year—on equipment both new and old. Farval always pays its way. You'll want the whole story. Why not investigate? Then invest!

Write for Bulletin 101 today. The Farval Corporation, 3275 East 80th Street, Cleveland 4, Ohio.

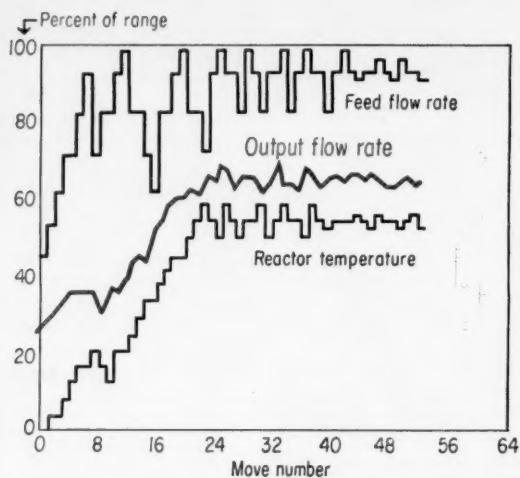
*Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing.
In Canada: Peacock Brothers Limited.*

Proved in 30 years of service, Farval manual and automatic centralized lubrication systems protect bearings of thousands of machines in industry. Wherever you see the familiar Dualine valve manifolds, dual lubricant lines and central pumping station, you know a machine is being properly lubricated.





Process control (left) optimizes styrene output (below) from catalytic dehydrogenation of ethylbenzene in Dow Chemical miniplant by regulating heat and feed rate.



New Concept Changes Process Control Outlook

Now operating on its first industrial job, new control system optimizes process by experimentation, bypasses need for expensive computing equipment.

Using a radically different control concept, Dow Chemical Co. now optimizes styrene output from a miniplant that catalytically dehydrogenates ethylbenzene. From initial startup through to final shutdown, Dow's system regulates process inputs to give maximum possible product output despite the influence of uncontrolled variables such as catalyst deterioration.

Before long, Dow hopes to operate its system, through addition of an inexpensive analog computer, to return maximum profit. And the company anticipates that ultimately it will be able to swing into full-scale production under such a setup.

Yet even before Dow's development reaches the full-scale stage, Sun Oil Co. will start operating a full-scale three-product distillation under optimized control at Marcus Hook, Pa.

► Optimize by Experiment —

Both of these installations are pioneering answers to an industrial dream—the dream of operating processes at optimum levels despite shifts in any of the controlled or uncontrolled variables. What makes them particularly unique is how they achieve optimization.

Through a method of logical experimentation developed by Westinghouse (*Chem. Eng.*, June 1957, pp. 284-286), these

Opcon systems* operate in a manner analogous to a human operator.

At Dow, for instance, whenever output shifts away from the optimum level, Opcon senses the shift. Then, it experimentally changes controllable input variables until output returns to the optimum point.

► **Analogous to Operator**—Like the human operator, Opcon knows little about the intricate non-linear mathematical relationships associated with optimizing. Yet, it does know how to experiment intelligently with input values to bring operation to an optimum level and hold it there.

As a dynamic part of the process, Opcon needs no precalculated, preset optimum level.

* Winner of the 1958 Industrial Science Achievement Award from the American Association for the Advancement of Science.

Rather, it searches out the optimum point for existing conditions. Recognizing that point when process reaches it, Opcon holds process to that level until shift in process variables forces search for a new optimum.

By virtue of this performance characteristic, Opcon is claimed able to deal with unpredictable process upsets caused by shifts in uncontrolled variables. Frequently, these effects are so complicated or so obscure that they defy the type of mathematical description needed for optimization by digital-computer control.

► **First Chemical Job**—With its miniplant installation, Dow is the first company to prove out the Opcon for controlling a chemical process. Controlling the input variables, feed rate of ethylbenzene and reactor temperature, Dow's Opcon maximizes output rate of styrene in the mixed product stream of styrene, unconverted ethylbenzene and some contaminants.

Major uncontrolled variable causing drift in the process is deterioration of the catalyst. And for any given level of catalyst activity, Opcon seeks out the optimum output level.

► **Step by Step** — Results are plotted above for a test run where the Opcon maximized styrene output rate. Steps taken by the Opcon control are numbered along the abscissa while percent of range is on the ordinate.

Note that output flow rate of styrene increases steadily until about move 20. Thereafter, it fluctuates somewhat as the inputs change. When input changes become relatively minor, output settles down to a fairly constant value.

Looking at the input curves, note that temperature starts at a low value and rises generally until about the 20th move. At about the 38th move, Opcon decreases the step size. For the remainder of the curve plot, temperature fluctuates around this point.

Feed rate of ethylbenzene climbs rapidly at first, then swings rather widely. This happens because output flow rate is not very sensitive to feed flow rate at lower temperatures. After further swings, Opcon reduces changes in feed rate to minimum steps and continues to operate around a steady value.

These curves do not cover a long enough operating period to show an example of drift and how the optimizing control recovers from it.

► **Block by Block** — To understand what constitutes the Westinghouse Opcon optimizing control, look at the block diagram on the left at the bottom of the page.

Sensing device on output Z sends a signal into the storage and comparison block. If this value is better than the last best value of Z, called the base point

value, the change in inputs which produced it is called a success. Or if worse, input change was a failure.

Output signal from storage and comparison block to the logic block is either a success or failure signal. The nature of this signal together with information from past moves enables the logic block to decide how to change the process input variables, both in magnitude and direction.

Acting on instructions signalled from the logic block, the set-point determination block adjusts process inputs X, Y or both.

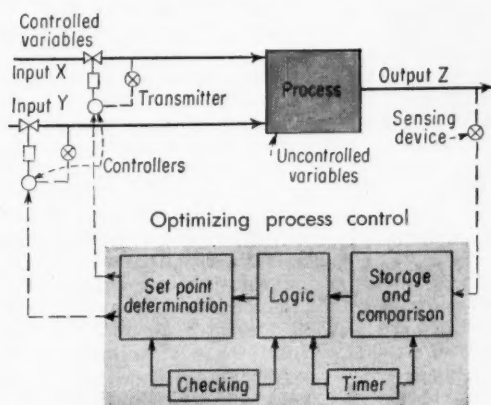
► **Close-Up of Logic**—Mechanization of the experimentation or search strategy depends upon the logic section. Sets of rules have been devised which describe strategies for specific purposes. These might cover situations such as finding the optimum most rapidly or following drift most efficiently.

Rules depend upon the concept of a base point about which a pattern of search moves are made. When a move from a base point produces a greater output, it establishes a new base point and base point value.

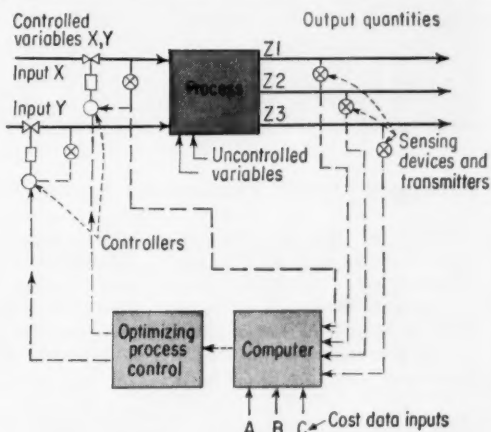
In the initial search, the system makes large moves. As these moves bring the process within range of the optimum level, they produce a certain pattern of successes and failures. These, in turn, cause the Opcon

Block Diagrams Show How Optimizing Control Fits Into Process

Basic optimizing control determines how to control process inputs in order to optimize process output.



Modified optimizing control setup uses analog computer to introduce cost factors for maximizing profit.



to shift to smaller moves or changes to arrive at the final optimum point. Again, a certain pattern of successes and failures indicates when that point is reached.

After reaching the optimum, either the original strategy or a different one can be used to detect and follow drift. If drift accelerates, size of moves can be increased to keep up with it.

Timer indicated on diagram provides time delay for process to reach equilibrium after changing input variables. Checking circuit permits periodic trial of logic section with test pro-

gram to be sure that none of large number of static components is malfunctioning.

► **Maximize Profit**—Dow's next step will be to maximize profit from its dehydrogenation of ethylbenzene. How this may be done is shown in the right-hand block diagram.

Inputs are controlled as before by set-point controllers. Outputs are Z_1 , Z_2 and Z_3 , where Z_1 might be the desired product and the other two would be byproducts.

These outputs are measured. Together with the magnitude of Y and cost data A , B , and C , they feed into a special-purpose ana-

log computer which solves the profit equation for the process. This is a simple equation and does not involve the process equations.

Output from the computer is a voltage proportional to operating profit rate of process. Opcon seeks to maximize this voltage just as it would any other process characteristic.

New Fuels May Spring From Our Coal Reserves

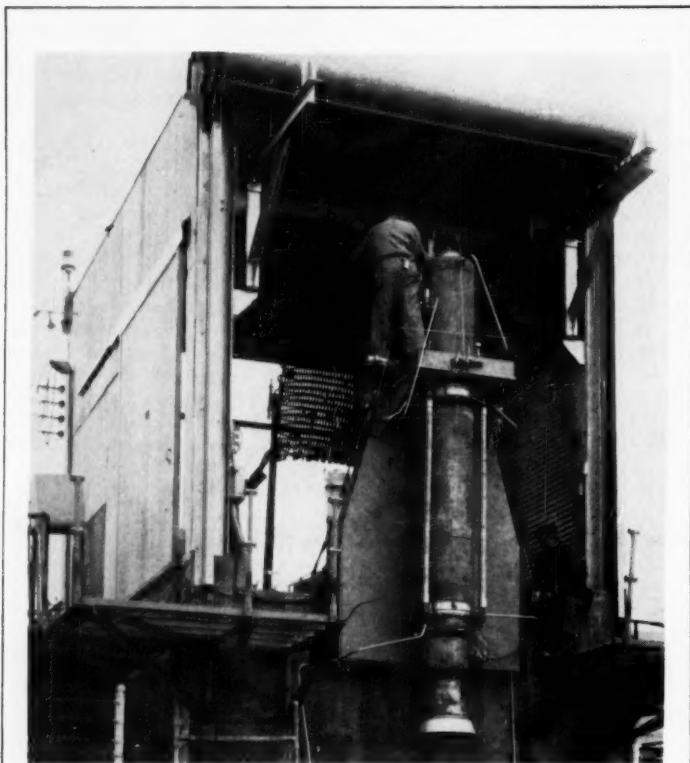
Standard Oil of Ohio and Consolidation Coal Co. (Pittsburgh) recently launched into a joint research program that will explore processes for making "liquid hydrocarbon fuels" from coal. Agreement stems from companies' joint experience in operating Mountaineer Carbon Co. (*Chem. Eng.*, June 30, 1958, pp. 54-56) which calcines petroleum coke for the aluminum industry.

Consolidation Coal has long been working on coal-to-oil processing at its laboratories at Library, Pa. Sohio will now add the efforts of its Cleveland research facilities. Firms predict five to 10 years will pass before any process goes commercial.

Consolidation has already piloted a low-temperature coal carbonization (LTC) process which yields 0.7-0.8 ton char and 24-34 gal. tar per ton of coal along with a low-Btu. gas. Tar is similar to petroleum fractions fed to a cresylic acid plant while char can be burned for power generation. LTC process is based on fluid-bed carbonization at 900-1,000 F. and 0-15 psi.

Consolidation has been operating a new cresylic acid plant at Newark, N. J. (*Chem. Eng.*, July 1957, pp. 228-231) in anticipation of a commercial LTC unit. But Consolidation has shelved indefinitely its plans for an LTC plant, citing "marketing reasons." Cresylic acid plant is operating on petroleum refinery wastes at the present.

Evidently the coal firm is relying on the new research program to develop more profitable fuels from coal's chemical potential, rather than going along with the cuts currently available from LTC tars.

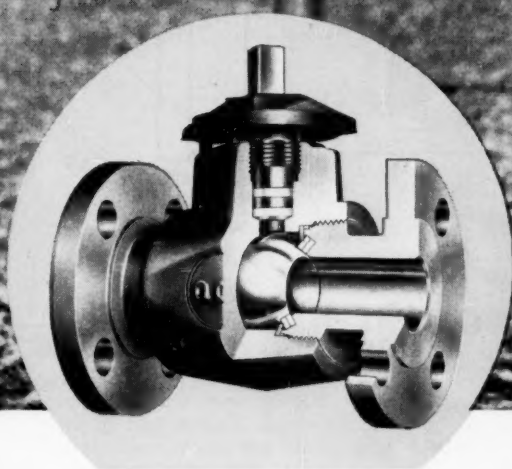


Packaged Missile Powerplant Speeds Launching

Above is Reaction Motors' recently tested 50,000-lb. thrust, pre-packaged liquid-propellant powerplant. Designed for immediate operation, power plant can be delivered and stored at a launching site complete with

propellants, needs no elaborate count-down. The 19-ft. unit above, on completing tests successfully, proved scalability of basic unit design and that it can be produced in a family of sizes for wide performance range.

**"There are no bugs
in this new product"**



Says Maintenance Foreman of large
gas processing plant.

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W-K-M's *Creative Engineering*
has been service-proved
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chlordane • Vinyl chloride • Butadiene
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Carbon bisulphide • Cleaning naphtha •
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gas • Coke oven by-product gas • Gasoline
(tank car) • Chlorinated solvents.

For 3½ years, users tested this new valve in the hardest services that could be found.

Now, W-K-M offers it to you as a **service-proved** new product, a new product with no bugs, a typical example of W-K-M's leadership in design, production and service.

This valve will deliver promised performance; you can specify it with complete confidence in its efficiency, economy, ease of operation and maintenance.

You should know more about it.

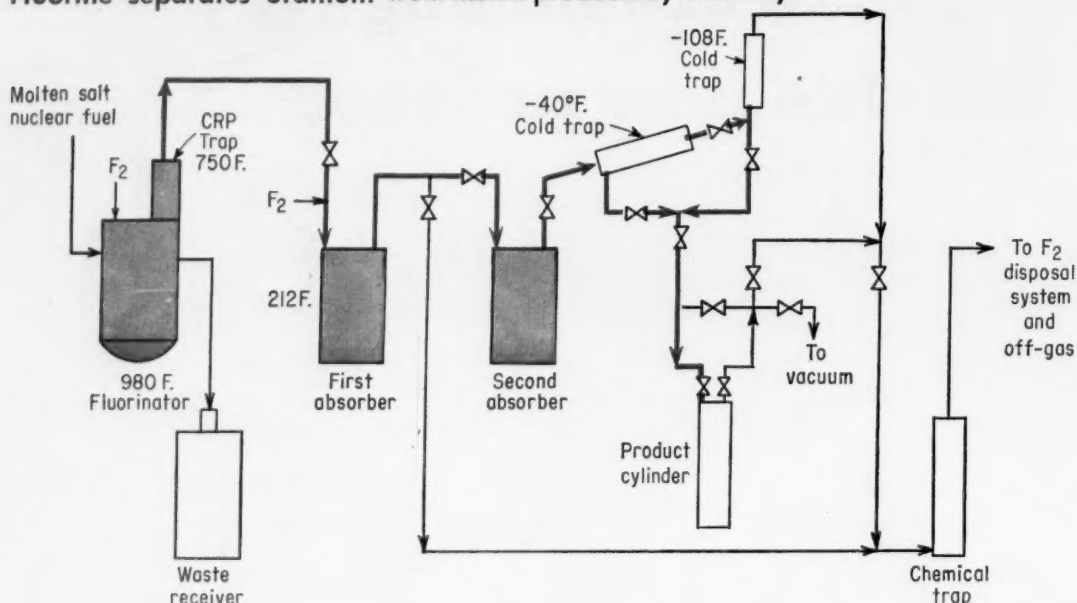
Write for Catalog 1000 for complete information.

AVAILABLE in carbon steel (ASA 150 lb., 300 lb.), and semi-steel (200 lb. WOG, 400 lb. WOG); sizes range from ½" through 6". Also ASA 600 lb., sizes ½, ¾ and 1".

W-K-M

DIVISION OF QCF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

Fluorine separates uranium from fission products by volatility



First Nonaqueous Recovery of Fuel Completed

Relying on volatility and absorption techniques, Oak Ridge completes the first pilot-stage recovery and purification of nuclear fuel by nonaqueous method.

Chemical engineering now claims another contribution toward development of nuclear energy. At Oak Ridge National Laboratories, engineers under W. H. Carr have successfully reprocessed a complete reactor fuel charge by a nonaqueous process.*

Taking molten salt fuel from the Aircraft Reactor Experiment (ARE), Carr's group separated uranium from fission products by volatility and absorption techniques. Through fluorination of the molten salt, Carr's men volatilized the uranium as UF_6 . Subsequent selective absorption on NaF , desorption into a cold trap and final heating produced pure liquid UF_6 .

In all, Oak Ridge pilot runs have reprocessed two complete

reactor charges. On the second charge, more than 99% of the uranium was recovered as UF_6 . No fission products were detectable in any of the UF_6 product. Total activity was what you'd expect from uranium alone.

► **Wider Use**—While the Fluoride Volatility Process was developed primarily to recover and purify uranium from molten-salt aircraft reactor fuel, it has wider applicability. It certainly could be used for molten-salt fuel from domestic power reactors. And it should prove useful on heterogeneous fuel elements, such as those in the Westinghouse-type submarine reactors, which will dissolve in molten fluoride salt.

► **Nature of Charge**—Fuel from the ARE was a fused salt containing 48 mole percent sodium fluoride, 49.5 mole percent zirconium fluoride and 2.5 mole per-

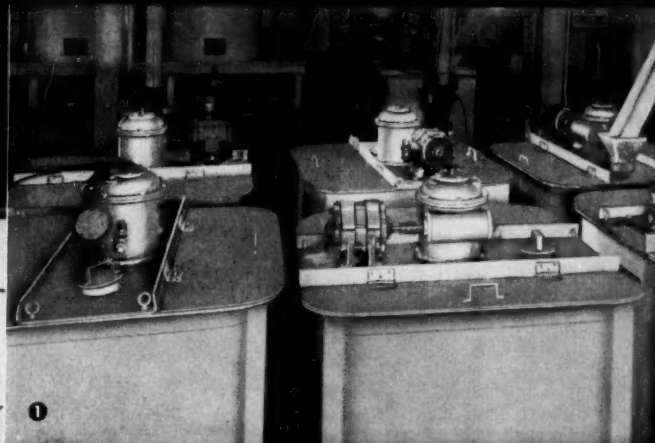
cent highly enriched uranium tetrafluoride. Charge had undergone only low burnup and then had passed through a long cooling period. That made it fit well the requirements for irradiated feed to the first pilot runs attempted using volatility techniques.

After reprocessing the reactor charge, ORNL proceeded with additional runs to develop more data. Feed material was essentially a non-irradiated salt similar to the ARE fuel. Some of these runs were spiked with high burn-up salt to obtain further decontamination data.

► **Nature of Separation**—To separate uranium from fission products, fluorine gas is bubbled through the 980-F. molten-salt reactor fuel. Fluorination converts the UF_4 to volatile UF_6 , which flows out of the fluorinator leaving more than 99% of the fission products behind in the salt.

After two or three hours, all UF_6 has passed off. Molten salt containing fission products is transferred to waste can, allowed

* Process details disclosed in paper by Carr at 1958 AIChE Annual Meeting, Cincinnati, Ohio.



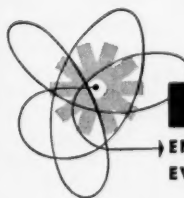
Improved Processing through Engineered Agitation

HOW IMPORTANT IS GOOD FLUID MIXING IN YOUR PROCESS?

REGARDLESS OF HOW SPECIALIZED your particular processing needs are, good mixing can be the difference between "run of the mill" and maximum yields.

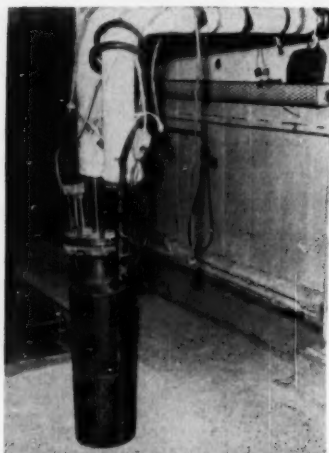
NETTCO MIXERS ARE PROCESS-RATED for optimum performance. Your particular process requirement is fully evaluated. And—it costs no more to get the full benefit of Netcco's wealth of agitation technology and broad application experience. Then—from design and pilot test to full process conditions, standard components are precision teamed to provide you with a Netcco mixer to meet your most exacting conditions. If good fluid mixing is vital to your process, then Netcco Engineered Agitation is vital to *you!*

PUT NETTCO ENGINEERED AGITATION TO WORK FOR YOU. From a full line . . . side drive, tank top, portable or tripod and unique continuous pipeline mixers, NETTCO can provide the answers to a wide range of mixing problems. See your NETTCO representative listed in Chemical Engineering Catalog or Refinery Catalog, or write for Bulletin 582, New England Tank and Tower Co., 87 Tileston Street, Everett 49, Mass.

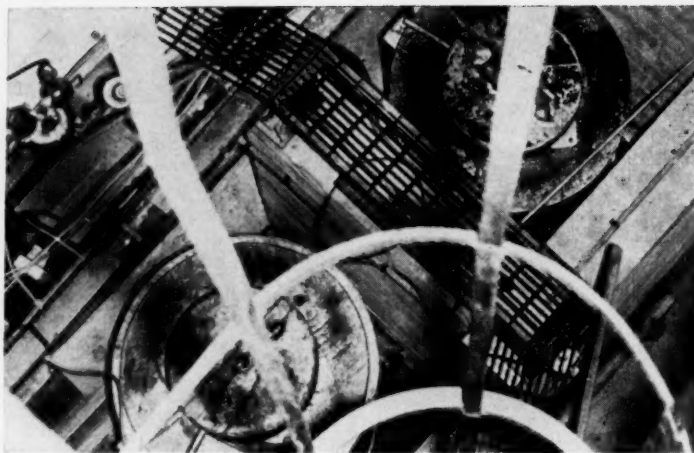


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1. Paint blending with Netcco tank top mixers on 400 gallon portable tanks.
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ABSORBER traps UF_6 gas which separates from fission products . . .



. . . FURNACE heats absorbers to liberate UF_6 trapped by sodium fluoride pellets for delivery to product cylinders.

to freeze and disposed of by burial.

Gases leaving the fluorinator pass through a bed of sodium fluoride pellets identified as the Complexible Radioactive Products Trap (CRP Trap). At an operating temperature of 750 F., this trap retains some of the volatile fission and corrosion products while UF_6 , excess fluorine and nitrogen pass through.

Discharge from the CRP Trap enters the first absorber which also contains sodium fluoride pellets. However, with temperature of this bed at a much lower 212 F., the UF_6 complexes with the sodium fluoride and most of the remaining fission products are absorbed.

Unabsorbed gases go through a chemical trap of sodium fluoride pellets at ambient temperature which assures that no UF_6 is lost. From here, gas passes through a caustic scrubber for removal of fluorine before discharging to off-gas system.

► **Nature of Recovery** — After completion of fluorination and absorption, a second absorber and two cold traps are swung onto the line. Then, the desorption starts.

Temperature of the sodium-uranium fluoride complex in the first absorber is raised to 750 F. During this rising temperature cycle, UF_6 desorbs and passes through the second absorber before condensing and freezing in

the cold traps (-40 to -108 F.). Any traces of contaminants leaving first absorber with UF_6 are trapped by second absorber.

Throughout desorption, fluorine gas flows through system to prevent reduction of UF_6 and to sweep UF_6 from absorber. Fluorine passing through cold traps flows through chemical trap and NaOH scrubber to off-gas system.

After desorption, cold trap and product cylinder connected to it are isolated and evacuated. Then, entire system is heated above 147 F., the triple point of UF_6 . Liquid UF_6 drains into product cylinder.

When all liquid product has drained out of traps, product cylinder is cooled to 32 F. to transfer most of remaining UF_6 vapor by convection. Lastly, product cylinder valves are closed and cold traps are cooled back to normal operating temperature. Any traces of UF_6 vapor remaining in system are frozen out in cold trap and remain there during next run.

Carr's group reprocessed the reactor fuel in 50-l (15.85-gal.) batches containing about 10 kilos (22 lb.) of uranium. Schedule was set up for two runs per week with two operators and a supervisor on each shift.

► **Data Highlights** — Data from the runs indicated that process consumes two to three times the theoretical fluorine requirement

of one mole for each mole of uranium. While some uranium is retained by the sodium fluoride absorbers, this is believed to be independent of the amount of UF_6 put through bed. Rather, it is caused by impurities present in the sodium fluoride.

Gross beta and gamma activity of every product cylinder from the batches was equal to or less than that produced by uranium alone. Since this gross gamma was generally from nine to 10 counts/min./mg. of uranium, gross gamma decontamination factor was about 10^4 .

When UF_6 product from these pilot operations was converted to UF_4 , it met purity specs.

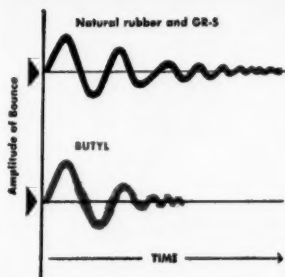
► **Operating Problems** — Corrosion of the fluorinator is serious, although not intolerable. Corrosive conditions reach their peak after partial fluorination when uranium is still present in the molten salt. Under these conditions, nickel (low carbon) seems most effective.

Feed salt for the runs had a high nickel content. This was increased further by buildup of nickel from corrosion. Since nickel has limited solubility in fused salt, it plugged the fluorinator piping until care was taken to cut back feed with nickel-free barren salt.

Oak Ridge intends to extend pilot plant studies of volatility processing to higher activity fuels and to heterogeneous fuels.



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ENGINEERS lower basket of nutrient into autoclave where quartz crystals will grow in hot alkaline medium.

Bell Opens Door to Man-Made Quartz Crystals

Using hydrothermal process in autoclave at high temperatures and pressures, Bell System engineers show how to make synthetic quartz crystals commercially.

Not satisfied with nature's rocks, Bell System engineers now grow their own in high-pressure autoclaves at Western Electric Co.'s Merrimack Valley Works, North Andover, Mass.

Bell's rocks happen to be large quartz crystals, essential components in long-distance communication equipment. And they are ample proof that America now could produce commercial quantities of such crystals.

► **What Man Wrought** — To outdo Mother Nature in producing large quartz crystals, R. A. Laudise and associates at Bell Telephone Laboratories worked with 1-in. by 1-ft. autoclaves to grow crystals about 1-in. square by 1½-in. long.

Then, R. A. Sullivan and associates at Western Electric proved out the laboratory findings by producing crystals in 6-in. I.D. by 9-ft. pilot autoclaves. Using 1.0-1.2 N sodium hydroxide medium, these units operate at 22,000-27,000 psi. and 653-680 F.*

*Process details disclosed in paper by Laudise and Sullivan at 1958 AIChE Annual Meeting, Cincinnati, Ohio.

On this scale, Sullivan's group grows crystals measuring 2-3 in. in each cross direction and 5-6 in. long at a 60 mil/day rate. Surpassing natural crystals in many ways, this synthetic quartz yields at least 2½ times more finished cut crystals than an equivalent weight of Brazilian crystals. Yet, Sullivan and his group could claim such success only after they had solved a fair share of scaleup problems.

► **Chips to Crystals** — In Bell's hydrothermal process, the vertical autoclave is filled between 75 and 87% of its free volume with alkaline solution. Small pieces of quartz placed in a basket at the bottom of the vessel provide nutrient for growth of crystals on seed crystal surfaces in racks at top of vessel. Growth takes place over periods varying from one to several weeks.

To make this growth possible, a temperature differential ranging between 36 and 126 F. must exist between the nutrient area and the seed plate area. In the hot lower region, the alkaline solution dissolves quartz and carries it by convection to the cooler

upper region. Here, the solution becomes supersaturated and deposits quartz on the seed crystals.

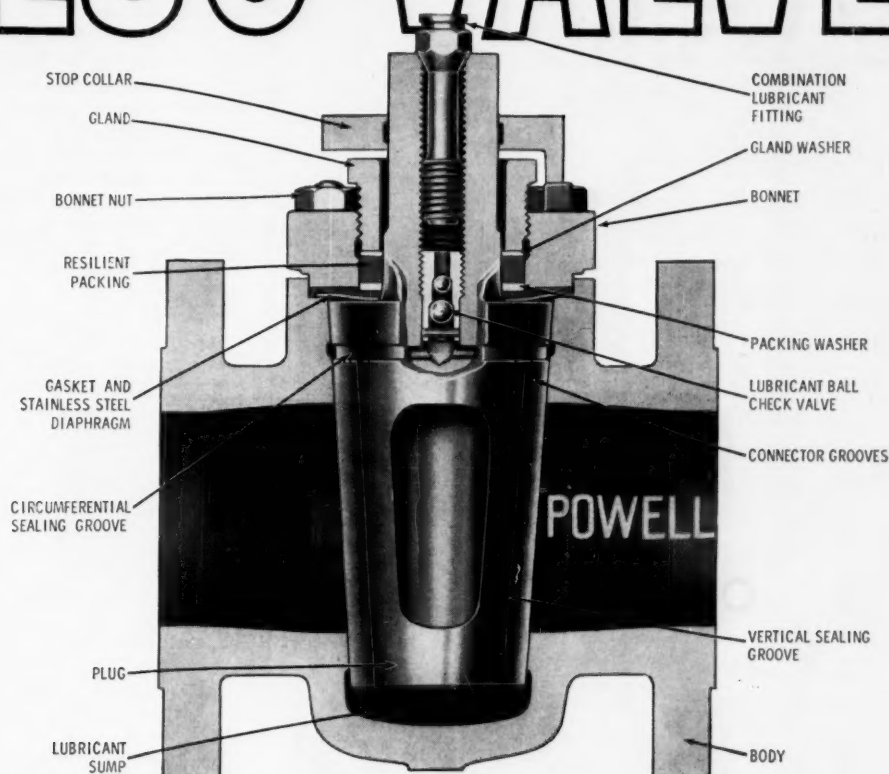
► **Features for Control** — A perforated metal disk or baffle plate between nutrient and growth regions decreases differences between crystals in rate of growth. Fastest growth takes place on seed surfaces cut approximately along the basal plane. And luckily these fast growing crystals are suitable for the type of cut crystals desired by Western Electric.

Maintaining isothermal condi-



CALIPER measurements reveal that crystals grow in autoclave at rates up to 60 mil per day.

POWELL LUBRICATED PLUG VALVES



Sectional view Powell Screwed Gland Lubricated Plug Valve.

Like all Powell Valves, Powell Lubricated Plug Valves are superior in their field . . . and have many advantages over other conventional types of Valves.

- Simple design: only three basic parts—Body, Bonnet, Plug.
- Quick, complete shut-off—a quarter turn will close or open the valve.
- Tapered Plug assures positive seating.
- Machined surfaces of plug and body are not exposed in the open position. Any media adhering to the plug when in the closed position is removed when plug is rotated.

- Cavity-free straight passage assures streamlined flow in either direction. Scale and sediment cannot collect.

Powell Lubricated Plug Valves are available in sizes $\frac{1}{2}$ " through 16", depending on the type required—Semi-steel 175 and 200 pounds WOG;—Carbon Steel ASA 150 and 300 pounds.

Powell can also furnish Lubricated Plug Valves in other alloys on special order.

For all your valve needs, make it a policy to consult your local Powell Distributor—or write directly to us.

THE WM. POWELL COMPANY

Dependable Valves Since 1846 • Cincinnati 22, Ohio

tions within the separate zones depends upon keeping perforations below 10% of total baffle area. Then, the temperature differential is confined almost entirely to the region close to the baffle; nutrient and growth zones remain uniformly even in temperature.

Temperature of the nutrient zone is held uniform by heating

top and bottom of this zone more than the middle, thereby countering flow of heat toward the ends.

Early in the pilot work, some of the seed plates tended to crack similar to stress cracking along the longest dimension. Apparently, this was due to deposited quartz having different lattice parameters than the natural

quartz seeds. By bringing the entire vessel almost to operating temperature and pressure under nearly isothermal conditions, then producing the desired differential temperature slowly, cracking is eliminated during formation of the crystals.

► Facts About Hardware—Before Western Electric launched its successful pilot trials, Sullivan's men worked out details of vessel construction to withstand the process conditions, believed to be among the most severe encountered in any process industry at present.

Either Croloy or SAE 4140 alloy were used for body material in the four autoclaves. Both materials have proved satisfactorily corrosion resistant under operating conditions.

Work to develop a closure that could be opened and closed many times, yet still retain sealing ability at high pressures, led to adoption of self-sealing, modified Bridgman closure.

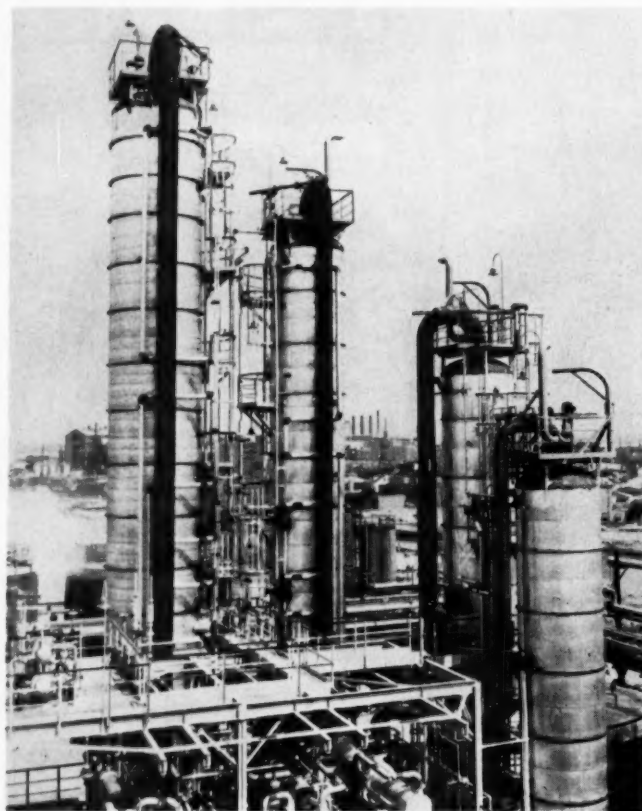
Vessels are heated with external band heaters operated on 440 v. and controlled by saturable reactors. Asbestos sheathing insulates the whole autoclave assembly.

NEWS BRIEFS

Boron trichloride: Dow Chemical Co. and U. S. Borax Research Corp. have engaged in a joint venture to perfect an economic process for commercial manufacture of boron trichloride, a highly reactive boron intermediate.

Hydrogen sulfide combatant: Mobil Oil of Canada, Ltd., is making available throughout the petroleum industry a new method of curbing deadly hydrogen sulfide gas during oil well testing. Method involves pouring ammonium hydroxide into drill pipe each time a new stand is pulled from a well.

Ammonia pipeline: Czechoslovakia has completed a 26-mi. pipeline to transport ammonia from its source near Most (northern Bohemia province) to a fertilizer plant at Lovosice. No details are available.



Naphthalene Distillation Unit Is World's Largest

Built for Allied Chemical's Plastics and Coal Chemicals Div., by Badger Mfg. Co., this continuous naphthalene distillation unit at Allied's Frankford, Pa., site has a capacity of well over 100 million lb./yr.

First three columns separate, in order, crude solvent used in producing styrene, crude raw

material for Cumar resins, and an intermediate fraction which is reprocessed. Fourth column distills off naphthalene. All columns are equipped with perforated trays and operate at reduced pressure. High-temperature heat for naphthalene column is supplied by a vertical direct-fired tube still.

EMERY Engineered WEIGHING SYSTEM NEWS

EVALUATE THE PRACTICAL ACCURACY OF YOUR ENTIRE TANK WEIGHING SYSTEM

DO NOT BE MISLED BY ACCURACY CLAIMS MADE FOR A SINGLE COMPONENT

Has it occurred to you that a glib sales claim of .1% accuracy in a weighing component is no guarantee whatever that the system will operate with such accuracy under normal service conditions? In fact, every instrument engineer knows that consistent accuracies of .1% under normal operating conditions are a practical impossibility.

Under controlled laboratory conditions consistent .1% accuracies are barely possible . . . but in the field . . . practically never!

Emery Engineered Weighing Systems are designed for the needs of each particular job. It is through this individual engineering that we are able to achieve a maximum accuracy which is impossible when components are lifted from stock.

NEW WAY-PAC BULLETIN IS NOW AVAILABLE

Our new Bulletin 582 covering the WAY-PAC line of engineered weighing systems is now being distributed throughout the industry. If you haven't done so yet, send for your copy right away.

When writing, refer to Item 1005.



In selecting your tank weighing system, investigate thoroughly all sales claims of fantastic component accuracy. Evaluate the practical accuracy of the entire system. Do not be misled by the accuracy claims that are made for a single component. After your evaluation . . . buy the system with the best practical approach to your weighing problem . . . the Engineered Weighing System by Emery.

When writing, refer to Item 1001.

INSTRUMENT COMPANIES RECOGNIZE DESIRABILITY OF STRONGER SIGNAL

Standardization on an electrical operating signal in the range of 10 to 50 millivolts for electrical instruments indicates the trend of today's thinking as evidenced by the instrument industry.

Should this standardization program become effective tank weighing system users may take note that the Engineered Weighing System by Emery can team up immediately with such instrumentation without the use of additional equipment.

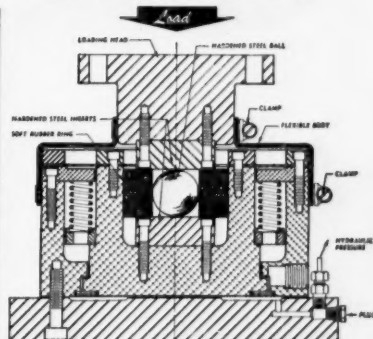
When writing, refer to Item 1002.

TANK EXPANSION DAMAGE PREVENTED WITH EMERY ENGINEERED WEIGHING SYSTEMS

The unique and exclusive Emery Rolling Ball Head built into the Emery Load Cells is your guarantee that no damage to the weighing system will result from inevitable tank expansion and contraction.

The Rolling Ball Head is a clever device which allows side motion of tanks due to expansion and contraction without sacrificing any of the accuracy of the Emery Engineered Weighing System. A system which does not take into consideration this expansion and contraction is not properly designed.

When writing, refer to Item 1003.



Key to protection of Emery Weighing Systems from side load damage is the unique design of the rolling ball head . . . an Emery exclusive.

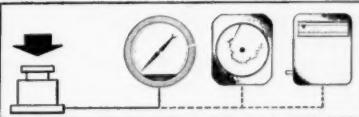
EXPLOSION-PROOF FEATURE VALUABLE IN MANY CHEMICAL TANK INSTALLATIONS

The importance of explosion-proof equipment in many chemical installations cannot be minimized. There is no room for deliberation . . . no opportunity for experimenting. Either the equipment is explosion-proof or not.

Emery Engineered Weighing Systems can be supplied to operate completely on either the hydraulic or pneumatic principle of load measurement. However, when electrical instrumentation is specified, we will supply this instrumentation in explosion-proof cases which have underwriter approval. An Emery Engineered Weighing System is available to provide positive explosion-proof protection in practically every

chemical application. Inquire for detailed information.

When writing, refer to item 1004.



Your Emery Weighing System can be completely hydraulic or pneumatic or it can contain electrical instrumentation in explosion-proof cases for positive protection.

The A. H. Emery Co., New Canaan, Conn.

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Item 1001 ☐ Item 1003 ☐ Item 1005 ☐

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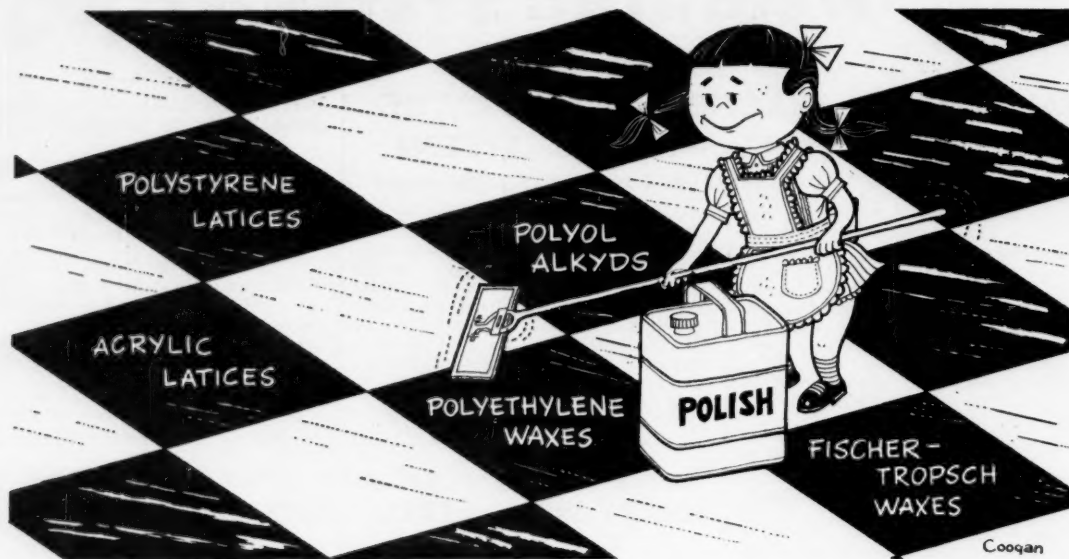
State _____



THE A. H. EMERY COMPANY
New Canaan, Conn.

Engineered WEIGHING SYSTEMS





Chemicals Team Up to Make a Better Polish

"Anything nature does, we'll try to do better"—a fair chemical-industry motto. And never truer than in polish, where chemicals supplant natural resins, waxes.

For years, two natural products—carnauba wax and shellac—were the backbone of self-polishing floor dressings. And even today only a limited list of materials can adequately substitute for these products in aqueous emulsion polishes.

But the list is there and growing. And well it might, for thanks to the marvelous array of do-it-yourself flooring materials available, consumer demands for easy-to-use floor polish have run sales up to \$150 million/yr.

Most items on the list are chemicals and polymers. Together they can, and do, produce completely synthetic floor polishes which have the specifications to satisfy the manufacturer and consumer and are free of supply problems.

► **Pushed Aside**—Thus carnauba and shellac, as well as other natural waxes and resins, have been shouldered out of many modern formulas for self-polishing wax. In their place are a host of semi-synthetic or wholly synthetic materials.

The new work horses are polymer latices like polystyrene and methyl methacrylate, making up the bulk of a modern polish. Chiming in to enhance the product's utility are such ingredients as Fischer-Tropsch waxes, oxidized microcrystalline waxes, emulsifiable low-molecular-weight polyethylene waxes, modified alkyd resins.

► **Enter Polystyrene**—One of the most promising synthetic replacements for natural resins and waxes in emulsion floor polish is polystyrene latex, first

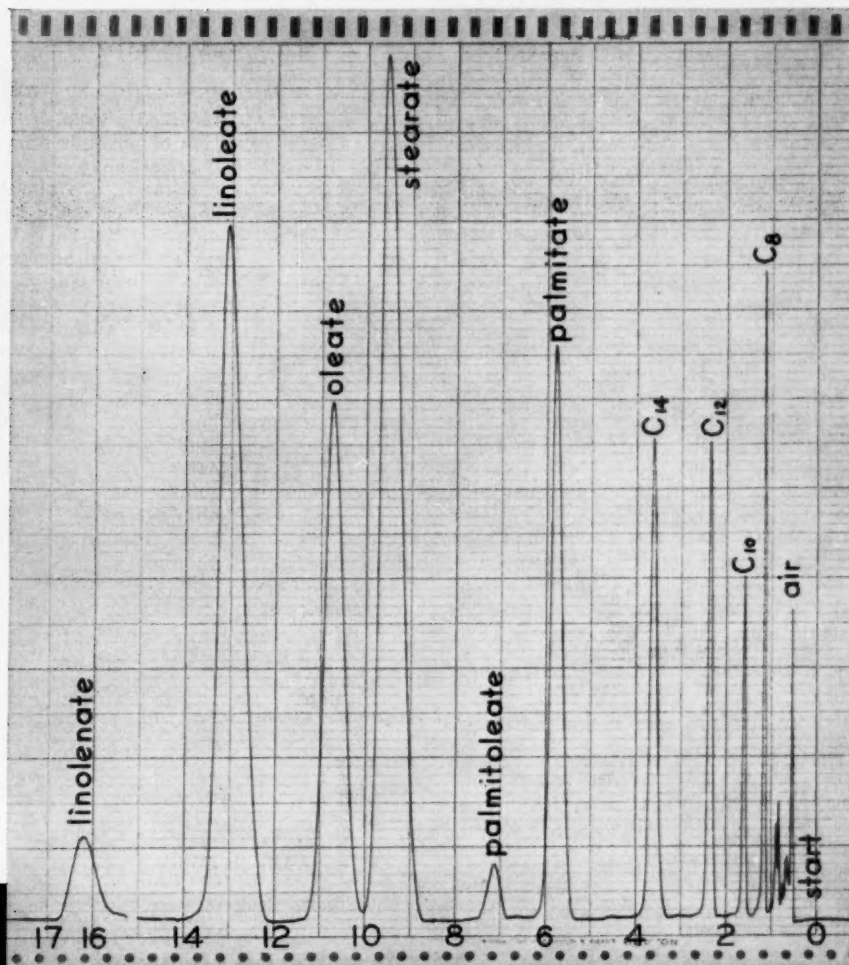
introduced several years ago. Polystyrene is hard, has a high refractive index (to impart high gloss), and is cheap.

But polystyrene is not film-forming, although this problem can be licked by use of plasticizers and modification of the chemical composition of the polymer. However, liquid plasticizers used as film-formers tend to leave the film via evaporation or migration; then the polystyrene embrittles and powders off. And chemical modification can cause color deterioration.

In emulsion polymerization of styrene, a broad range of molecular weights may result. A sensible fraction may therefore be too high for easy plasticization, resulting in an undesirable non-uniformity.

Polystyrene also degrades in the presence of ultraviolet light, discoloring upon aging.

Thus, while modified polystyrene emulsions show real promise, they are not the complete answer, although their



in 17 MINUTES—
Complete Separation of Methyl Esters of C₁₈ Fatty Acids
...with the P-E Model 154-C Vapor Fractometer

Do you use fatty acids in your product or process?

If so, you know the importance of determining their composition by their analysis as methyl esters. And gas chromatography has proven to be the quickest and most accurate analytical tool for the separation and identification of C₁₈'s.

The fractogram shown above, run by the Perkin-Elmer® Model 154-C Vapor Fractometer—at 210°C and 20 psi—utilized a P-E "P" column. Note how well the C₁₈ peaks are resolved.

At Perkin-Elmer, we strive to provide the finest analytical instrumentation—the maximum ability to perform gas chromatographic separations—at a price

within the reach of every laboratory. Our continuing engineering program is directed actively to this end.

For more product information and four technical reprints* on gas chromatography, write us at 785 Main Avenue, Norwalk, Connecticut.

*Hausdorff, H. H. and Brenner, N., "Gas Chromatography—Powerful New Tool for Chemical Analysis," *Oil and Gas Journal*, editions of June 30, July 14, July 21 and August 4, 1958.

Brenner, N., O'Brien, L., and Coates, V. J., "Analytical Applications of a Triple Stage Gas Chromatographic Instrument," Paper presented at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, March 6, 1958.

Norem, S. D., "A Combustion Device for Use in Conjunction with Chromatographic Columns," *Gas Chromatography*, Academic Press, Inc., New York, N. Y., 1958 pp. 191-194.

Golay, M. J. E., "Vapor Phase Chromatography and the Telegrapher's Equation," *Analytical Chemistry*, 29, 6, June, 1957, pp. 928-932.

INSTRUMENT DIVISION
Perkin-Elmer Corporation
 NORWALK, CONNECTICUT

price and supply are good. **►Enter Acrylics**—Latices of ethyl acrylate and methyl methacrylate, on the other hand, do not exhibit many of these shortcomings. Particle size can be in the 0.05-micron range, color is white, latices form films much more readily than do polystyrene emulsions. Acrylic latices, moreover, are quite stable to light. At 50¢/lb., acrylic latices are only a few pennies higher than modified polystyrene.

But they have two shortcomings: being softer than polystyrene, they don't wear quite so well; because their index of refraction is lower, they produce less gloss at equal solids. However, these disadvantages, it's claimed, can be overcome by proper formulations.

The degree of gloss, color and water-spot resistance which acrylic latices impart to floor polish formulations has brought a new dimension to the industry. Acrylic emulsions offer advantages never before available to the wax formulator.

►Variety of Waxes and Resins—Wax emulsions—like carnauba, oxidized microcrystalline, oxidized Fischer-Tropsch or oxidized polyethylene—are used with the polymer latices to round out the properties of the final polish. Oxidized polyethylene waxes, for example, give self-healing properties (good scuff resistance).

Alkali-soluble resins, used with polymer latices, increase hardness and improve leveling and spreading characteristics of the final polish. Reichhold

Chemical's Waterez resins—modified alkyds from esterification of phthalic anhydride with polyols—have excellent water resistance, are almost white in color. They show no change in aging on the floor, harden up a polish film without darkening it, and spontaneously spread over many surfaces.

For the future, copolymers of styrene with a second, or even third, monomer seem to be in the cards. Styrene is cheap, hard, contributes high gloss. Modifications with other monomers to improve UV resistance, color, ease of plasticization and elimination of dusting, is possible and already being considered.

This story was excerpted from a talk given by Reichhold Chemicals' Lee Prince at a Montreal meeting of Canadian Mfrs. of Chemical Specialties.

Reinforced Plastics . . . Up-and-Coming Uses

Markets	Used in 1958 (Million Lb.)	% Change 1957-58	
Aircraft, missiles	18.5	-26	Thrust-chamber housings, baggage containers, air conditioning ducts
Appliances	7.4	+48	Filament-wound water-softener tanks and hot-water tanks
Boats	37.0	+46	Pleasure-boat hull lengths of 30-40 ft; all Navy craft up to 50 ft.
Construction	31.5	+25	Simulated stone or brick sheathing; cladding for plywood, steel
Consumer products	24.1	- 5	Furniture, outboard-motor shrouds, luggage
Containers, trays, industrial housings	7.4	+48	
Electrical	7.4	+48	
Pipe, tanks, ducts	5.5	+65	
Transportation	29.6	-12	Jeep wheels; diesel-locomotive hood and cab roof; White truck cab
Miscellaneous	16.7	+10	
Total	185	+10	

Reinforced Plastics Ride Higher on New Uses

Up 10% last year to 185 million lb., up another 15% this year, to 210 million lb.—that's how sales of reinforced plastics have been striding ahead. Doing the pushing is a plethora of new applications, many of which were discussed last week at the Chicago conference of the Reinforced Plastics Div. of the

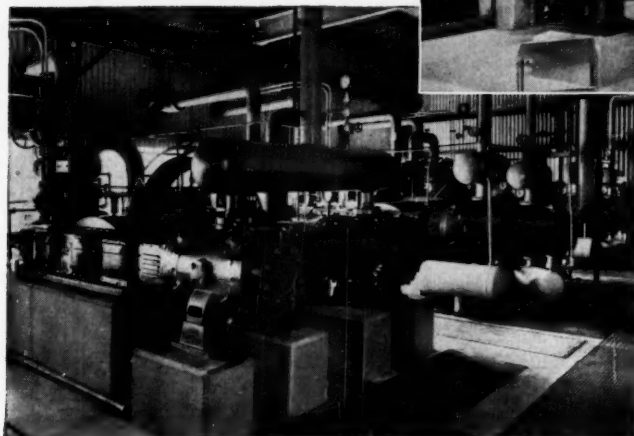
Society of the Plastics Industry.

The transportation field, together with boat and construction markets, offers the greatest potential for reinforced plastics both in volume and variety of parts.

Many in the RP industry believe their products will make great inroads in markets form-

erly dominated by die-cast aluminum and molded plywood. (Institutional seating and outboard-motor shrouds are examples of these markets already deeply penetrated by RP.) Parts larger than, say, distributor heads can be formed of reinforced plastics with less expensive equipment, less costly

SAVE with STEAM



UREA MANUFACTURE ▶

This 860-hp XPV compresses carbon dioxide in four stages for the manufacture of urea. There are four XPV compressors in this chemical plant, including ammonia synthesis gas circulators.

*Don't waste your steam —
use its power with . . .*



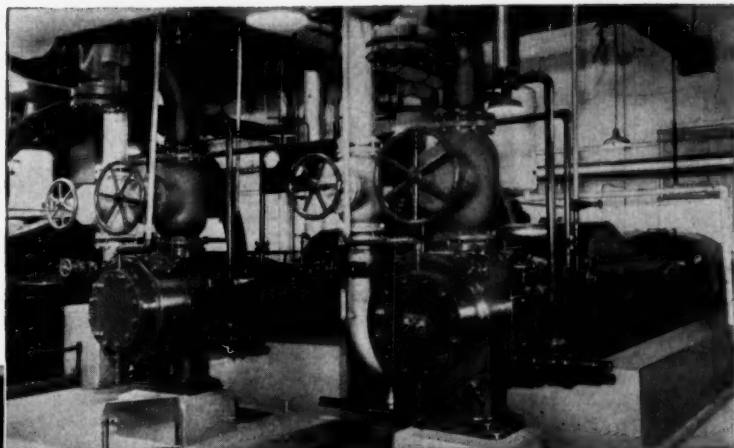
steam-driven compressors

Ingersoll-Rand's modern steam-driven compressors can turn your steam into compression power to suit any process conditions. These heavy-duty XPV units are available in a complete range of sizes up to 1500 hp (other types to 4000 hp), for any pressure or vacuum and for most steam conditions. Compare the features of XPV compressors, and see the reasons for their unmatched performance records:

Dust-proof, leak-proof, fool-proof running gear — Completely sealed frame keeps dirt out, oil in. Full-floating precision aluminum bearings never need adjustment, so the unit may be kept sealed and on stream.

Filtered, full force-feed lubrication — Wear is minimized by pressure lubrication of all bearing surfaces. Proper

*In engineered products, there's
no substitute for experience.*

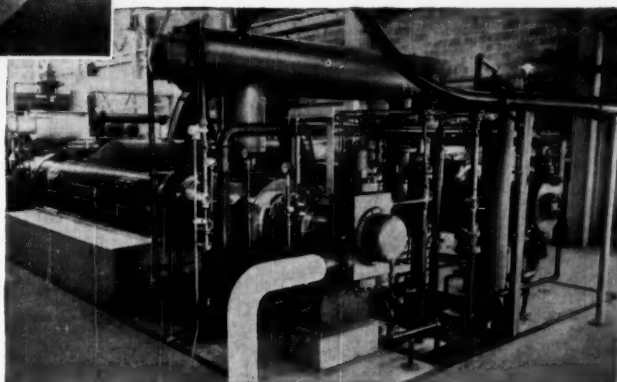


REFRIGERATION

One of two Ingersoll-Rand XPV compressors handling ammonia for refrigeration in a large Midwestern plant. Two of these modern units are installed in the space formerly occupied by a single old-type compressor, and provide greater capacity with safer, more efficient operation and much less down time. Another XPV in the plant compresses air.

CATALYTIC CRACKING

Three XPV compressors in a large refinery: in foreground is a single-stage unit handling flue gas; two 3-stage units in background compress inert gas. There are hundreds of XPV's on all refinery services, including hydrogen recyclers with "NL" non-lubricated compressor cylinders.



oil is supplied by separate systems to running gear, compressor and steam cylinders.

Adjustable automatic steam cutoff and hydraulic governor permit close control and variable speeds to suit any process conditions.

Efficient compressor cylinders with Channel Valves — Ingersoll-Rand has more process compressor experience than any other manufacturer; this experience assures the proper compressor combination for your job.

Individual Analysis of your requirements, and soundly-engineered equipment to meet them — that's the backbone of Ingersoll-Rand's fine reputation. Call your I-R representative today for assistance with your process needs.

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molds and with no more, and sometimes less, finishing cost.

Of the 1958 sales of RP materials, resins accounted for 53% (about 100 million lb.); reinforcement, about 33%; fillers, pigments and activators, about 14%.

Polyesters are still by far the busiest resin. But there's a growing role for epoxies in aircraft, missiles, tanks, ducts, pipe, electrical panels, tooling, and architecture; for phenolics in aircraft, missiles and electrical parts; and for acrylics in sheeting and paneling.

Reinforcement materials are still dominated by fibrous glass. Use of asbestos continues to grow, however, particularly where high-temperature resistance is needed. Synthetic fabrics, sisal, metal and paper are also used as reinforcing agents by industry. Let's look for reinforced plastics' up-coming uses in some of their major fields of application:

Aircraft and Missiles—Actually, reinforced plastics sales to this area tumbled more than 25% in 1958, at the same time that the variety and number of reinforced-plastic components increased. Industry explanation for both phenomena: "... the present transitional stage of commercial aircraft from propeller planes to jet planes, of military aviation from supersonic to hypersonic manned aircraft, and from attack fighters to guided missiles."

Reinforced plastics are well fitted, quality-wise, to move ahead in the aircraft-missile field. Their strength-to-weight ratio, from two to ten times better than that of steel, puts RP into filament-wound pressure vessels for jet fuels or gases, laminated hatches, bulkheads, cargo liners, doors and all types of containers (e.g., preload baggage containers for the Boeing 707).

Reinforced plastics' thermal insulation properties have induced Convair to switch from metal to reinforced plastics (over a plastic honeycomb or metal core) on future designs of the Atlas ICBM's pods, which house all onboard electrical equipment. (This kind of construction is now used to house the thrust cham-

bers for the Atlas' two main engines.)

Their ease of fabrication puts reinforced plastics into complex contours like the Lockheed Electric's air conditioning ducting. Their electrical insulating properties account for their use in radomes, battery boxes, terminal boards, and commutation insulators.

Appliances—Filament-wound tanks (for water softeners and hot water systems) are among the fastest growing uses for RP in the appliance field. Better surface appearance via improved gel coatings should accelerate RP's acceptance by manufacturers of wash tubs, television and hi-fi housings, air conditioning units.

Boats—This largest user of RP accounted for 20% of all sales in 1958. Easy styling and maintenance is the key to the RP success here.

About 72,000 reinforced plastic boats were turned out last year, half in the 14-15-ft. category. RP manufacturers see half the small-boat market for their products by the early or mid-60s. More and more RP are going into hulls of larger boats—those 30-40 ft. in length. And the Navy has specified that all its craft up to 50 ft. in length will be made of these materials.

Construction—With panel uses leading the way, reinforced plastics rang up a 25% sales increase in this field for 1958. Continued improvement was made in the quality of panels, encompassing greater uniformity in color and thickness, and greater resistance to weathering.

One new building application for reinforced plastic panels is sheathing which simulates the appearance of stone, brick, or wood. Other examples of sheathing: RP-covered plywood for heavy-duty or sanitary service, RP-covered steel for corrosion resistance, RP-covered pulp boards for decorative applications.

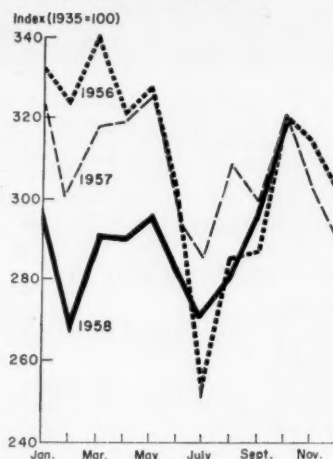
Consumer Products—Furniture and outboard-motor shrouds are the big gainers in 1958. Nearly 3 million lb. of RP will be used for the latter application this year. New surface effects in RP should generate new markets in luggage. Molded chairs and

seats should pick up big gains in 1959.

Containers, Trays, Industrial Housings—Containers and trays claim about half the reinforced-plastic materials going into this field, are expected to call for twice as much in the next four years—about 8 million lb. Work to develop reinforced plastics impervious to continuous steam sterilization could open new vistas.

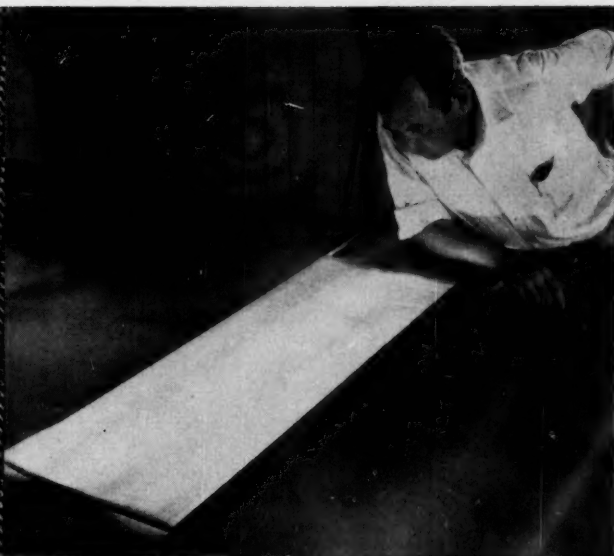
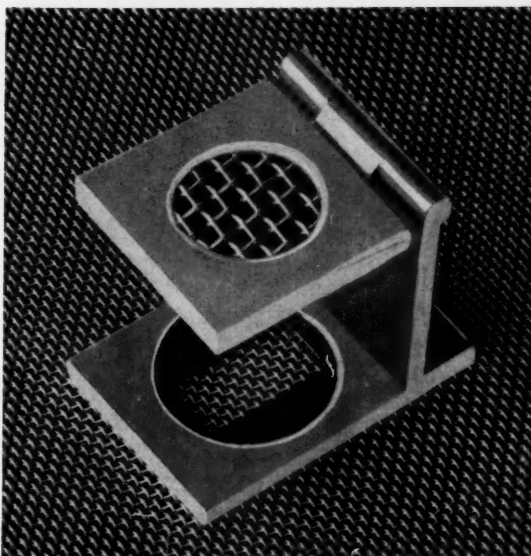
Transportation—Reinforced plastics sustained heavy losses here in 1958 because of the auto-industry slump. The variety of potential applications was on the increase, though: e.g., jeep wheels now on test with the government; all-reinforced-plastic cab for the White truck; and the hood and cab roof of the New Haven's "Roger Williams" diesel locomotive.

Chemical Consumption



Consumption by Industries

	Sept. (Final)	Oct. (Est.)
Coal products.....	7.7	8.7
Explosives	11.0	11.4
Fertilizer	56.3	69.5
Glass	27.8	29.1
Iron & steel.....	14.0	16.2
Leather	4.1	4.3
Paint & varnish.....	35.0	33.8
Petroleum refining...	30.1	30.1
Plastics	28.1	30.6
Pulp & Paper.....	36.8	41.4
Rayon	25.2	26.1
Rubber	6.8	7.5
Textiles	9.2	10.3
Total	292	319



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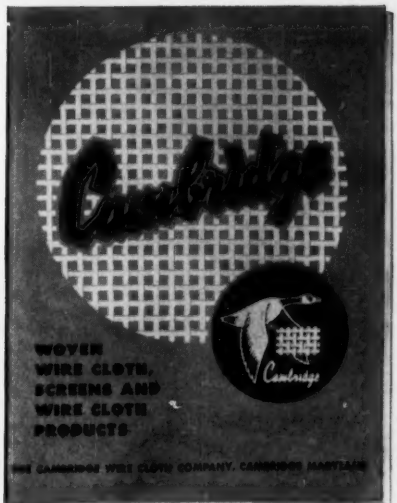
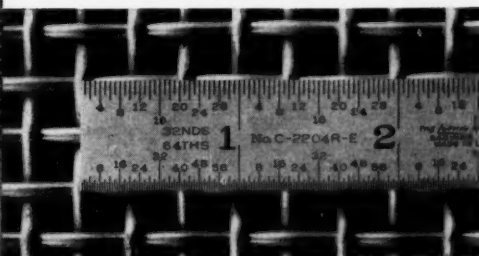
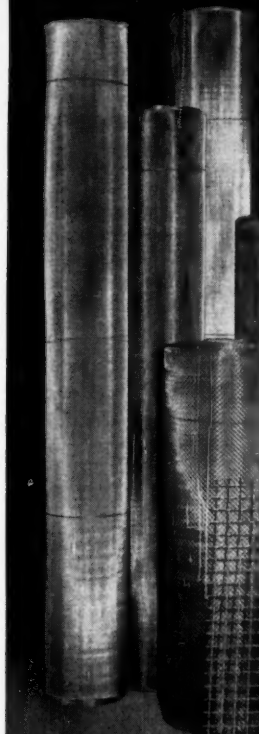
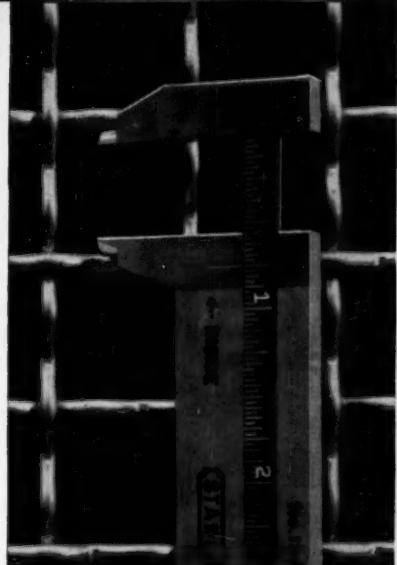
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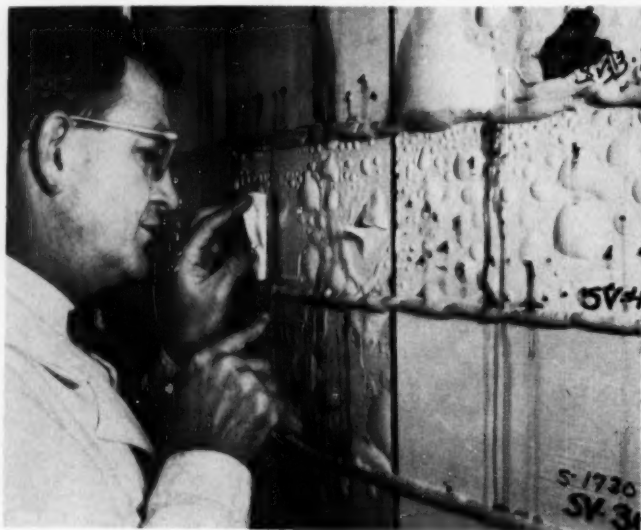
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New House Paint Resists Blistering Under Severe Test

Panel section at lower right shows a new blister resistant paint film adjacent to sections coated with conventional oil paint and badly blistered under extremely severe conditions.

Blistering—long the most serious problem in paint for frame houses—results when moisture, migrating through walls from a building interior, is trapped by old-style paint films which cannot breathe. The new paint is an acrylic emulsion, recommended

for use with a special primer, also new. The combination is chemically engineered to allow moisture vapor to breathe through while shutting out water penetration coming from the outside.

Other claims for the new system: 50% more durable than oil type coatings, dries to the touch in 30 min., ready for second coat in an hour, can be applied to a damp surface. — Du Pont Co., Wilmington, Del. 82A

Polyurethane Foam

New catalysts allow 1-shot systems for polyether-based foams.

A new catalyst for the manufacture of polyether urethane foams appears many times more active than fast amine catalysts now commonly used by industry. Called Niax Catalyst D-22, it is a special grade of dibutyl tin dilaurate.

Because of its tremendous activity, it has been possible in preliminary evaluations to effect a one-step conversion of polyethers to polyether urethane foams. These foams have previously been prepared in two-step operations, with the first step producing a prepolymer. But within recent weeks two products, besides Niax D-22, have been offered for one-step processing: Mobay's

organotin-containing catalyst, reported to be dibutyl tin di (2-ethyl hexoate); and Houdry Process Corp.'s triethylenediamine, called Dabco (*Chem. Eng.*, Dec. 15, 1958, p. 70).

Studies with Niax Catalyst D-22 have included use of the material alone and in combination with other catalysts. (Mobay's organotin is used in combination.)—Union Carbide Chemicals Co., N. Y., N. Y. 82B

Plasticizer

Offers permanent flexibility in a broad range of PVC applications.

A new, fast-blending polymeric plasticizer aims at providing permanent flexibility in a broad range of general-purpose PVC applications.

Called Santicizer 409, it is a polyester derived from adipic acid. Molecular weight exceeds 2,000. It marks the first polymeric plasticizer for Monsanto, which markets over 70 monomeric plasticizers.

Santicizer 409 is described as highly resistant to extraction and migration, low in both odor and color and highly compatible under humid conditions.

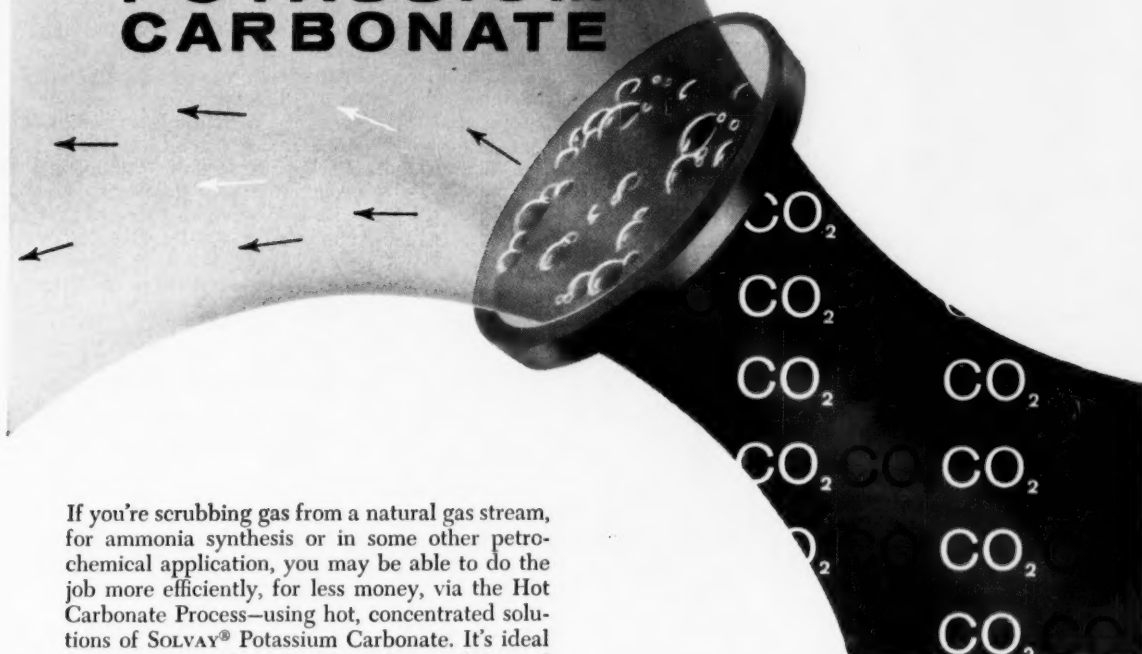
Typical Properties

	Santicizer 409	Equal Priced Polymeric
Appearance.....	Clear, vis. liq.	Yellow, vis. liq.
Acidity.....	0.6	2.7
meq./ 100 gm.		
Color.....	1	4
Gardner		
Moisture.....	0.05	0.05
%		
Odor.....	Faint ester	Marked
Pour.....	40	50
point, F.		
Refr. Index.....	1.4654	1.4664
25 C.		
S. G., 25/.....	1.084	1.087
25 C.		
Vis. poises.....	30	22
@ 25 C.		
Efficiency.....	1.30	1.34
factor		
Lb./gal.....	9.04	9.06
25 C.		

It is suggested for use in wire coatings and film for electrical

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- ☐ "Improved Process for CO₂ Absorption"—Chemical Engineering Progress.
- ☐ "Which CO₂ Removal Scheme Is Best?"—Petroleum Refiner.
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tape, general film and sheeting, coated cloth, adhesive backed films. Commercial quantities are available at a tank car price of 39¢/lb.—**Monsanto Chemical Co., St. Louis, Mo.** 82C



Solid Polyurethane

New solid industrial tire has four times conventional wearing qualities.

Tires designed for pallet roller wheels and steer wheels are now being made on a pilot plant scale from Neothane, Goodyear's name for its cast polyurethane type rubber. Tires are said to have four times the wearing qualities of conventional tires.

Two additional developments in urethane casting rubbers: A liquid urethane prepolymer, "more versatile than today's plastics;" a new cross-linking agent whose lack of water content eliminates undesirable "Swiss-cheese" effect due to gas formation or blowing.

► **Quadruples Wear**—In industrial uses, Goodyear's new tire helps fill the gap between presently available solid rubber tires and steel wheels, particularly where cushioning is desirable.

The new material has extremely high resistance to cutting and chipping, as well as excellent oil, weather and abrasion resistance characteristics. High load bearing is another outstanding feature. In addition to longer life, use of the new type tire reduces floor maintenance costs and protects

equipment and loads against damaging shock through its cushioning action. — **Goodyear Tire & Rubber Co., Akron, Ohio.** 84A

► **Versatile Prepolymer**—The new prepolymer is designed for use in compounding elastomeric, semi-rigid and rigid plastics. This combination of properties and versatility of application makes the product, called Solithane 113, useful for casting molds of complex shape, and for encapsulating and potting operations.

► **Coatings Too**—In addition to use as a casting medium, Solithane 113 can be formulated to provide protective coatings for both metallic and non-metallic surfaces which can easily be sprayed, dipped or brushed.

Properties

S.G., 80F	1.073
Viscosity, poises, 80F..	200
Color	light amber
% NCO	10.6

The prepolymer system has two distinct advantages: Eliminates handling free diisocyanate, minimizing possible toxic reaction; provides a low exotherm which permits flexibility in controlling product uniformity. — **Thiokol Chemical Corp., Trenton, N. J.** 84B

► **Cross-linking**—A new cross-linking agent for polyurethane rubbers, 1,4-butanediol anhy-

drous, is said to perform far better than other glycols in the manufacture of urethane casting rubbers and surface coatings.

Product contains 0.05% maximum moisture. Presence of water would cause formation of gas bubbles during the reaction impairing strength, flexibility and durability of the rubber products.

► **No Swiss Cheese**—1,4-butanediol anhydrous is easily incorporated: The cross-linking reaction of polyesters and other hydroxy-terminated polymers with diisocyanates proceeds smoothly through intermediate stages from viscous and pourable to the final rubberlike product without gas formation.

Bulk drum quantities are now available at 60¢/lb. Eventually price is expected to go down to 45¢.—**General Aniline & Film Corp., New York, N. Y.** 84C

Fluorocarbon Resin

New grade makes possible 1-mil electrical tape.

Void-free moldings and very thin electrical tape for wire-wrapping are made possible by a new grade of fluorocarbon resin designated Teflon 7 TFE-fluorocarbon resin.

Tape as thin as one mil can

—Newsworthy Chemicals—

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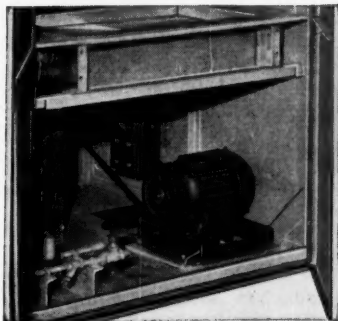
Acrylic emulsion makes blister-resistant house paint....	82A
Catalyst allows 1-shot polyether-base urethane foam....	82B
Plasticizer offers permanence in many PVC uses.....	82C
Solid urethane tire wears better.....	84A
Urethane prepolymer has extra versatility in casting....	84B
Cross-linking agent for fewer holes in urethane rubber..	84C
Fluorocarbon resin halves electrical tape thickness.....	84D
New rigid foam: equipment's familiar, resin's not.....	86A
Silicone modified resin resists moisture, flame.....	86B
Ytterbium metal can be had 99% pure.....	86C
Diphenolic acid gains a commercial producer.....	86D
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High power conversion efficiency at low cost is the major advantage of the semi-conductor rectifier. But this high efficiency — as high as 95% — can be obtained only when the unit is *correctly applied*.

Allis-Chalmers 30 years of experience in developing, manufacturing and *applying* rectifiers assures you of the highest conversion efficiency. This background of experience, plus vast research and engineering facilities, is available for a thorough analysis of your requirements. Then,

specific, unbiased equipment recommendations are made — dictated solely by your requirements — because Allis-Chalmers makes all types of rectifiers.

Every semi-conductor rectifier installed by Allis-Chalmers has performed to the complete satisfaction of the user. Your local A-C man can tell you how a semi-conductor rectifier can be applied profitably to your operations. Call him. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.



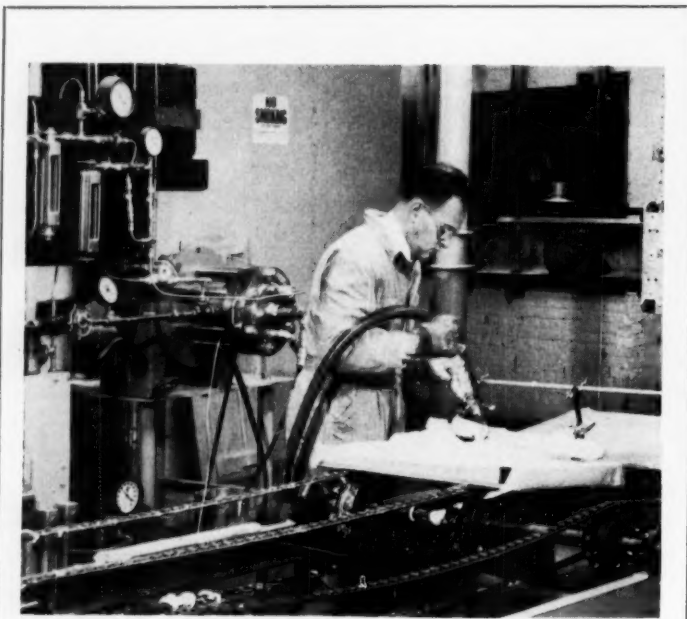
ALLIS-CHALMERS

be skived from cylinders of the new material. Previously, the thinnest electrical tape of TFE resin was two mils.

The new molding and extrusion powder, available in commercial quantities, is granulated to ultra-fine particle size. It offers such processing advantages as low pre-form pressures and uniform density throughout complex molded parts. Tensile strength and elongation of parts molded from Teflon 7 are also outstanding.

Potential uses include highly impermeable molded sheeting for tank linings and chemical service, nonporous tubing, gaskets, and pump diaphragms.

Available in experimental quantities since 1955, Teflon 7 is being produced in volume from new facilities at the company's Washington Works, Parkersburg, W. Va. A volume quantity price of \$5/lb. for purchases of 24,000 lb. or more has been established.—Du Pont Co., Wilmington, Del. 84D



New Rigid Foam: Equipment's Familiar, Resin's Not

Equipment conventionally used to make flexible foams, latex or vinyl, has been adapted to an unusual self-bonding rigid foam called Estafoam. Introduced a year or so ago (*Chem. Eng.*, Dec. 1957, p. 174), Estafoam is unsaturated polyester for which stabilizers have been developed to permit mechanical foaming.

Either the Oakes type mixer shown above or Votator gas absorption apparatus achieve complete mixing in seconds and "whipped" resin is ready for piping to the point of deposit.

Densities as low as 2 lb./cu. ft. corresponding to a blow-up of about 30:1, are readily obtained.

Its foams have compressive strengths on a par with urethane; for example, 20 psi. for 2-lb./cu. ft. foam. Another unusual aspect of this foam is that 10% by weight of glass fibers can be incorporated into the mix.

Raw materials costs are below urethane's, above polystyrene's. The complete foamable mix is in the 40-50¢/lb. price range. — Vanguard Products, Inc., Newark, N. J. 86A

BRIEFS

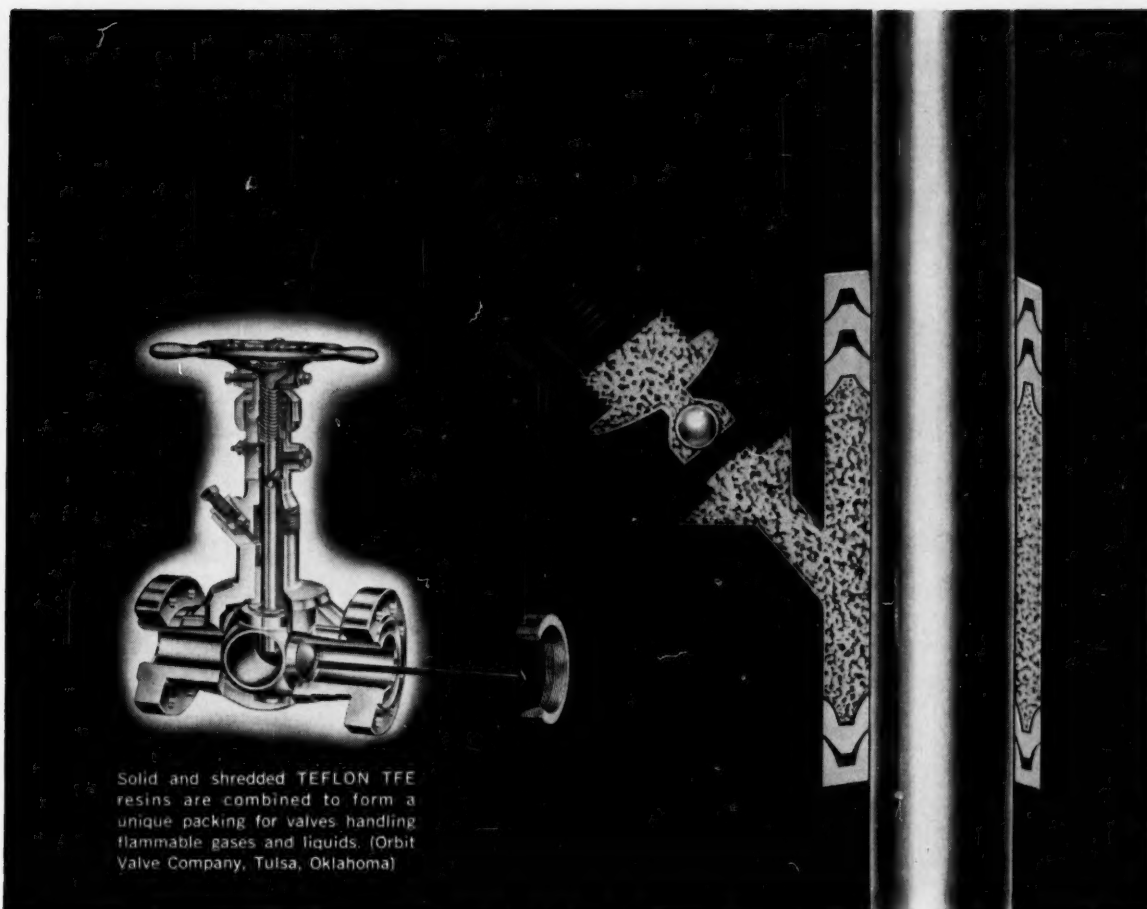
Silicone modified filled encapsulating resins has been designed for use in treating electronic components that require high moisture resistance and flame retardance. It is called Fosterite SFR BT-3199.—Westinghouse Electric Corp., Pittsburgh, Pa. 86B

Ytterbium metal of 99% purity in lump or ingot form, or in fabricated shapes is now available. Its melting point and density, significantly lower than those of other rare earths, suggest usefulness for semi-conductor and electronic use.—Nuclear Corp. of America, Burbank, Calif. 86C

Diphenolic acid manufacture and sale under the trademark DPA marks the company's entry into the chemical specialties field. Expected to find use in coatings and resins, lube oil additives, agricultural chemicals, synthetic detergents and emulsifiers and many other specialty products, it is said to combine in one chemical characteristics previously available only from two or more separate chemicals.—S. C. Johnson & Son, Racine, Wis. 86D

L-histidine monohydrochloride N.F. and L-histidine free base are now commercially available. Because of the high degree of functionality imparted by its imidazole group, histidine should be especially attractive for a variety of chemical preparations, particularly peptide synthesis. These items are the most recent additions to the company's steadily growing series of natural amino acid and biochemical products. Last year it introduced 31 such products. — General Mills, Minneapolis. 86E

Fluorocarbon silicone rubber, Silastic LS-53 has been reduced to \$18/lb. in 1,000-lb. quantities and \$24/lb. in less than 10-lb. lots. New prices represent reductions of from 11% to 18%.—Dow Corning Corp., Midland, Mich. 86F



Solid and shredded TEFLON TFE resins are combined to form a unique packing for valves handling flammable gases and liquids. (Orbit Valve Company, Tulsa, Oklahoma)

New pressurized packing of TFE resins stops leakage of flammables in chemical valves

The properties of TFE resins give you exceptional latitude in designing all types of sealing devices. TFE resins can be used up to 500°F. and offer low coefficient of friction. The extreme chemical inertness of TFE resins is unparalleled among packing materials.

This unequaled combination of properties makes possible the packing design pictured above. TFE-fluorocarbon resins are used to make the V-rings and main valve seat. Shredded TFE resins are mixed with other ingredients to form the plastic packing. The use of TFE resins in the rings, seals and packings means reliable, easy-turning valves, resulting in lowered maintenance costs and the reduction of fire and safety

hazards. In gasoline plants, valves of this design are handling mixtures of gaseous hydrocarbon feed to fractionators as well as the column reflux liquid. The packing is unharmed by distillates, condensates, solvents, salt water, hot water or corrosive gases.

In your designs, too, there is a place for TFE resins at the hot spots, the friction points, the sealing areas. See your local processor of fluorocarbon resins (listed in the Yellow Pages under "Plastics") or for additional technical data write to: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Rm. T-1029, Du Pont Building, Wilmington 98, Delaware.

In Canada: Du Pont of Canada Limited, P.O. Box 660, Montreal, Que.

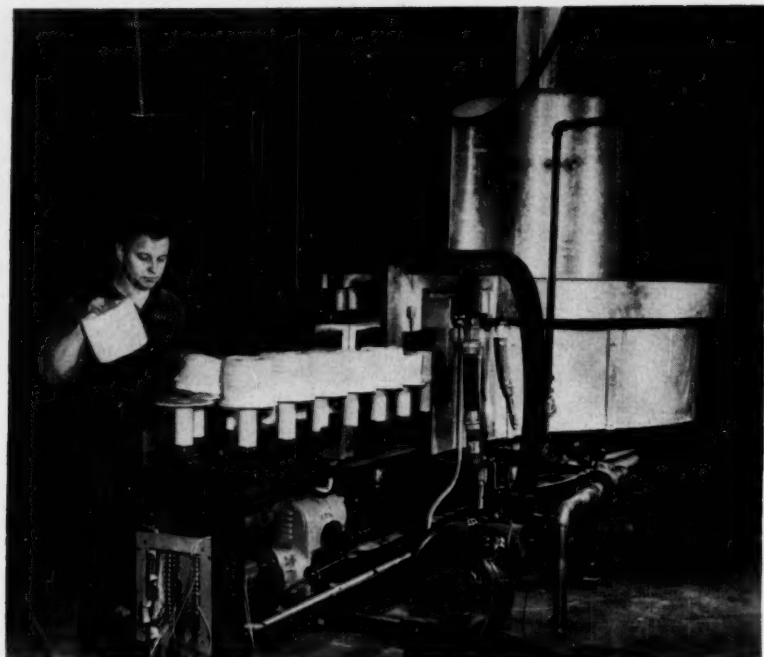


TEFLON®
TFE-FLUOROCARBON RESINS

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

CHEMICAL ENGINEERING—February 9, 1959



Drying Problem? Try New Dielectric Heater

Proved advantages of the Thermatool dielectric heater include drastically reduced drying times, lower floor-space requirements and precise quality control.

Over the past several years, the synthetic-fiber industry has searched for quicker ways of drying water-laden rayon cakes without sacrifice of product uniformity. Recently, New Rochelle Tool Co. came up with one successful answer to the problem—their Thermatool dielectric dryer. And now it appears that these machines, or modifications thereof, may be headed for wider use in many other segments of the process industries.

► **Why Use Dielectric Heat?**—Rayon cakes have traditionally been dried in ovens, sometimes 150 ft. long and 10 ft. wide. Drying times in these ovens

varies from a minimum of about 40 hr. to as much as 130 hr., depending on fiber quality desired.

Thermatool rayon cake dryers, two of which have been in successful operation for many months, have slashed drying time to 5-7 min. And floor space requirements for the new units are only 15 x 15 ft.

In addition to time and space savings, New Rochelle claims that Thermatool's precise control of the drying process yields superior products, regardless of normal variations of charge size or moisture content. Moreover, the machine protects these products from degrading effects of atmospheric gases with an

enshrouding cloud composed almost exclusively of steam.

► **New Applications Unfolding**—Recent contact between New Rochelle and key men of industry discloses some other very interesting possibilities for dielectric (radio-frequency) heat in both organic and inorganic processing.

For instance, small batches of either aqueous liquid chemicals or moist solids (e.g. non-conducting precipitates, crude essential oils, etc.) are frequently submitted to a moisture-removal period of 24 hr. or more. Depending on the nature of the material and the end result desired, a modified Thermatool could do the same job in a matter of seconds or minutes.

Or, since dielectric heat can affect complete sterilization of active or dormant infestations, anticipated applications extend

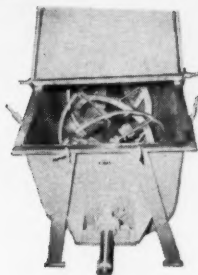
NEW...

STRONG-SCOTT INDUSTRIAL RIBBON BLENDER

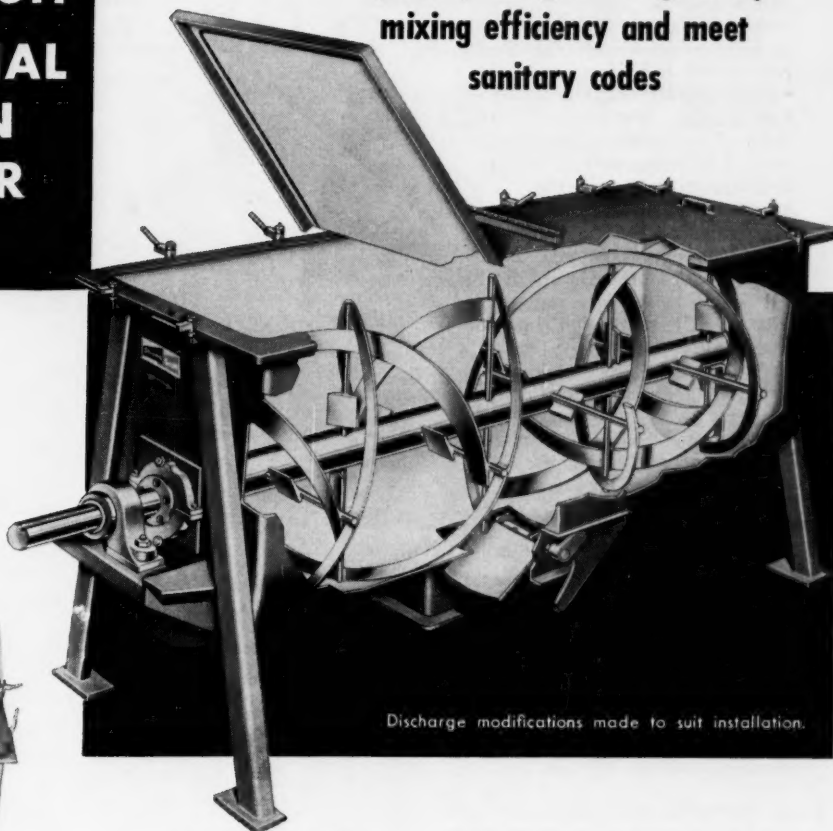
**Specially designed to give top
mixing efficiency and meet
sanitary codes**



Rounded tub ends prevent material hang-up, neoprene cover-seals provide dust-tight fitting.



- Swing or slide-type discharge gate, curved to eliminate dead pocket.
- Unique coupling permits vertical removal of agitator assembly without disturbing shaft ends and bearings.
- Heavy-duty, outboard anti-friction bearings.
- Air-purge, lip seal or stuffing box seals readily removed for quick cleaning.
- Dust-tight covers, with quick-action clamps.



Discharge modifications made to suit installation.

Top mixing efficiency with the new Strong-Scott Ribbon Blender mixer on dry or semi-dry materials, has been proven through continuous testing. The Ribbon Blender also meets requirements of health codes where necessary.

The ability to thoroughly and quickly mix is provided by a unique "ribbon assembly." The smallest amount of additives are thoroughly mixed in a matter of minutes. Special smooth-surface, cornerless welding and rounded corners throughout, leave no place for material to gather. The cover is seal-tight for maximum cleanliness and dust control.

Nine different size units ranging from 16 to 300 cubic feet working capacity are available in stainless steel or carbon steel. Jackets for heat transfer mediums also available.

PLAN '59 Modernize now for growth and profits

The **Strong Scott** Mfg. Co.

451 Taft Street N. E., Minneapolis 13, Minnesota

to the manufacture of organics destined for biological media and nutrients. Likewise, modified Thermatool units may find an economical niche in the food processing industry.

► **Construction and Operation**—Essentially, Thermatool consists of an insulated doughnut-shaped chamber and an integral 300-megacycle oscillator. The chamber houses several pairs of electrodes and part of a chain-type conveyor system. High-pressure steam coils maintain all portions of the chamber above 212 F. to prevent interior sweating.

Accessory equipment includes a switchgear cubicle incorporating protective devices; a transformer that steps-up supply voltage; a rectifier cubicle that converts high-frequency a.c. power to d.c.; a heat exchanger, circulating pump and a centrifugal blower.

In operation, an operator places the moist rayon cakes (or other moist products) on spindles fastened to the conveyor. As the rayon passes between the high-voltage electrodes and grounded electrodes, each cake is heated throughout, and most moisture evaporates in about 2 min.

Removed vapor is collected and condensed. Heat recovered from the condenser is returned to the plant's cake-washing operation in the form of hot water. An electronic device protects both equipment and product by interrupting power flow within several millionths of a second after accidental arcs.

► **Cost Considerations**—Two-thirds of all electrical energy delivered to a Thermatool appears as useful heat; one-third of energy input is lost in the multiple transformation from purchased power to high-frequency heat.

Of the useful heat, 75% is recovered as hot water. Studies show that cost of input power may vary from one-fourth to three times as much as that for conventional drying methods.

Labor costs are very low. One unskilled operator can perform all loading and unloading on equipment having a nominal capacity equivalent to 5 tons/day dried rayon. First cost for the

Thermatool runs about \$140,000.—**New Rochelle Tool Co., New Rochelle, N. Y.** 88A



Cold Trap and Baffle

Modular components for high-vacuum systems.

Lower liquid nitrogen losses and more effective condensation of backstreaming oil molecules are the functions of two new vacuum-system components—an all-stainless-steel cold trap, and a nickel-plated baffle. Both units are flanged to mate with any of the manufacturer's 4-in. components.

Each CT-400 cold trap provides 8 to 10 hr. of continuous operation for each 600-cc. filling of liquid nitrogen. The BAF-400 baffle employs both internal and external cooling coils to halt oil molecules backstreaming to the vacuum system.—**Veeco Vacuum Corp., New Hyde Park, N. Y.** 90A

Tank Gage

Measures both water interface and product level.

Sensing element of a new dual-operation electronic tank gage is a quarter-length antenna suspended in the tank. Radio-frequency signals of minute amplitude are transmitted to the antenna. A rise or fall of product level in the tank

causes an imbalance between the antenna-detected signal and another fixed signal.

This imbalance causes the sensing element to move either up or down, following the product level. Accuracy is guaranteed as $\pm \frac{1}{16}$ in.

When the system is used to measure water interface, the same sensing element moves below product level and continues sounding until it reaches water bottom. This action is actuated by a switch on the main control panel. A kit is available for conversion of the manufacturer's older tank-level units to the new dual-operation systems.—**Gilbert & Barker Mfg. Co., West Springfield, Mass.** 90B



Dust Collector

Designed to handle large volumes of bulky dust.

Designated as Model 24, a new high-efficiency cyclone separator, which operates in the 2,000- to 3,000-cfm. range, features a self-cleaning radial fan that gives high performance at low horsepower requirements. In laboratory tests, Model 24 has proved its ability to separate 99.8% of steel grindings (by weight), 99.5% sawdust and 84% fine corn starch.

A 7½-hp. motor operates the fan. Separator inlet is 10 in.; outlet is 12 in. The standard base contains a convenient pull-

NEW! direct tank-mounted LIQUID LEVEL TRANSMITTER



Exclusive static pressure connection for closed vessels above or below atmosphere . . . eliminates need for second instrument.

This sensing diaphragm capsule flange-mounts directly on side of tank. All wetted parts of Type 316 stainless steel, with optional plastic coating for further corrosion protection.

with DIRECT
3-15 psi
air output signal

IDEAL FOR: Viscous or corrosive fluids, slurries, and solids-in-suspension, as well as "easy-to-measure" fluids.

Now you can measure the level of "difficult" or easy-to-measure fluids — economically, without the complication of floats or bubble tubes, and with sustained high accuracy over the entire range span.

Flange-mounted directly to the side of an open or closed tank, the Type 13FA Transmitter eliminates piping and purging. Its stainless steel diaphragm capsule senses level changes instantly. Conventional tubing leads its output air signal directly to standard 3-15 psi receiver-recorders and controllers without need for intermediate signal converters.

The 13FA provides an accurate, trouble-free solution for level measurement problems. Write for detailed information, or ask your nearby Foxboro Field Engineer to explain its application to your specific process. The Foxboro Company, 362 Neponset Ave., Foxboro, Mass., U.S.A.

FOXBORO

REG. U.S. PAT. OFF.

LIQUID LEVEL TRANSMITTERS

out drawer having a 9-cu. ft. storage capacity. An optional cloth after-filter bag enables heat conservation by permitting the recirculation of dust-free air.—Torit Mfg. Co., St. Paul, Minn. 90C



Ribbon Blender

Construction enables easy cleaning between batches.

According to the manufacturer, a new mixer for dry or semi-dry materials incorporates many features that enable it to meet the requirements of sanitary codes.

Rounded tub ends and curved discharge gates prevent material hang-up in corners. Quick-action clamps permit easy removal of the sectionalized cover. And a neoprene gasket makes the unit dust-tight.

Available in either stainless or carbon steel, the Industrial Ribbon Blender comes in nine sizes with capacities ranging from 16 to 300 cu. ft. Optional features include choice of internal weldment finishes and heating or cooling jackets.—Strong-Scott Mfg. Co., Minneapolis, Minn. 92A

Centrifugal Pump

Prevents gas binding and loss of prime.

A new centrifugal pump known as the Vapor-flo Motor-pump is available for flooded suction services where vortexing or vaporizing may develop. Its special impeller has only three vanes; impeller passages diverge toward the periphery instead of converging.

Since liquid leaves the periphery faster than it enters the eye, a partial vacuum is formed. Any gases present fill the vacuum, and leave the pump without interfering with liquid flow.

Vapor-flo Motorpumps come in sizes with 1½- to 3-in. discharge connections; motor ratings vary from 2 to 7½ hp.—Ingersoll-Rand Co., New York, N. Y. 92B



Solids Flow Valve

Mounts on existing equipment via special adapters.

Compact and stainless, the new general-purpose Solids Flow valve is designed for operations requiring controlled discharge and flow of dry, granular powders. Interchangeability of all components with shelf items results in low initial cost and easy field maintenance.

A removable neoprene liner covers the valve body; vane and O-ring shafts feature Type 18-8 steel construction. Available accessories include adapters for mounting, a plastic bag adapter and a close-off cover for vacuum service. Solids Flow valves come in 8-, 10-, and 12-in. sizes.—Patterson-Kelley Co., Inc., East Stroudsburg, Pa. 92C

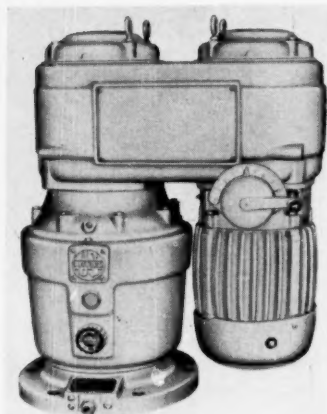
Adjustable-Speed Drive

Has no brushes, commutators, slip rings.

Designed to supply precise operating speeds for process machinery, the new Adjusto-Spede drive is suitable for continuous operation at full load

in ranges as high as 34:1. For intermittent use, it will operate from 0 to full speed, or at any rpm. in between.

Adjusto-Spede comes in ratings from ¾ to 7½ hp. with a stationary field construction—all brushes, commutators and slip rings have been eliminated to reduce maintenance. The single casing houses both a.c. motor and eddy current clutch. A tachometer feedback circuit monitors the drive shaft, and automatically corrects speed as controlled from a remote operating station.—The Louis Allis Co., Milwaukee, Wis. 92D



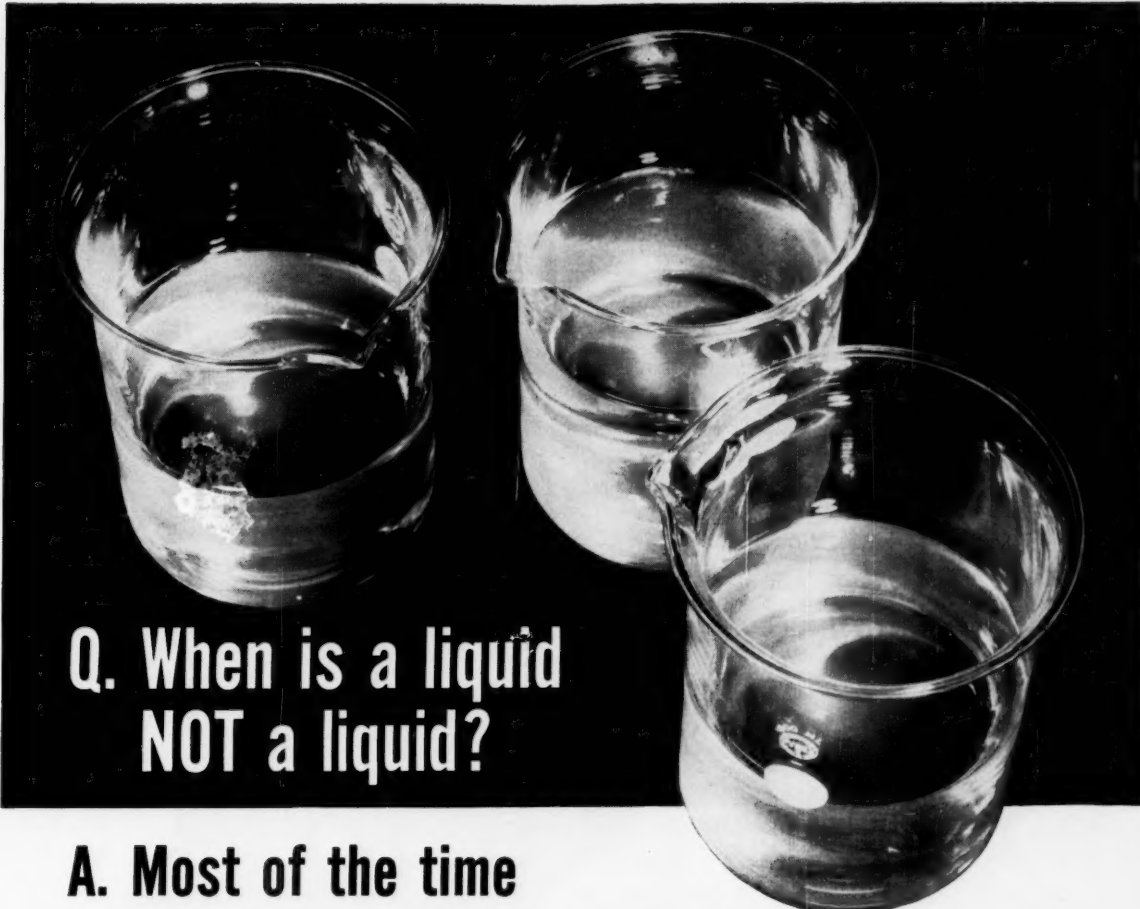
Agitator Drive

For flexible control of mixing operations.

Designed especially for agitator duty, a new variable-speed drive combines a high-speed a.c. motor, a mechanical variable-speed transmission and double reduction gearing into a single integrated unit. No electronic or d.c. components are incorporated.

Several methods of speed control are possible: Handwheel, remote mechanical, remote electrical or Varitrol automatic control. The new units are available in 3- to 30-hp. sizes and 30 to 380 rpm.; speed variations range from 2:1 to 7:1.—U. S. Electrical Motors, Inc., Los Angeles, Calif. 92E

Digitizer
and other equipment news
on page 162.



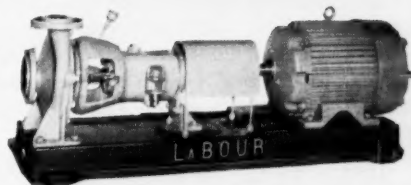
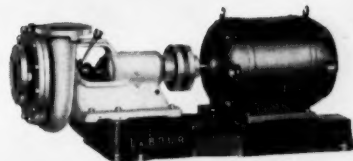
Q. When is a liquid NOT a liquid?

A. Most of the time

Pumping liquids in chemical plants would be a lot easier if you didn't have to pump other things, too. Gases, for instance—vaporized from the liquid by lower absolute pressure on the intake side. Or air, entering through imperfect pipe joints or entrained by an upstream process or condition. Then there are solids—sediment, crystals or just plain dirt, depending on what you are pumping and from where.

Most of the time, in pumping chemicals you've got to deal with one or more of these troublemakers. That's when you need LaBour. Open impellers with generous clearances lick the solid-particles problem. And LaBour design permits handling up to 20% air or gas mixed with the liquid—in non-priming pumps.

"The facts of life" must be faced in chemical plants as elsewhere. A thoughtful appraisal of your less-than-ideal situation will save you a lot of future trouble, because you'll have LaBour pumps on the job.



ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

LABOUR



THE LaBOUR COMPANY, INC. • ELKHART, INDIANA, U. S. A.

CHEMICAL ENGINEERING—February 9, 1959



It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

No internal wearing parts.
No valves, pistons, or vanes.
No internal lubrication.
Low maintenance cost.
Saves floor space.
Desired delivery temperature
Automatically maintained.
Slugs of liquid entering pump
will do no harm.
75 pounds in a single stage.

NASH ENGINEERING COMPANY
312 WILSON, SO. NORWALK, CONN.



TO MARK PROGRESS



LADISH

Controlled Quality

LIGHT WEIGHT WELDING FITTINGS

developed
for
economical,
dependable
low pressure
piping systems

LOWER COST

Substantial savings realized in purchase price of fittings and pipe.

REDUCED WEIGHT

Important weight reductions achieved by reducing wall thickness to correspond with service requirements.

GREATER FLOW

Larger inside diameter provides increased flow capacity.

EASE OF INSTALLATION

Reduced weight facilitates handling . . . speeds installation.

AVAILABILITY

Stocked in sizes 4" through 24". Wall thicknesses range from .188" to .250".

CONFORMITY TO SPECIFICATIONS

These fittings meet all requirements of ASA Code for Pressure Piping B31.1—1955 and B31.1.8—1955, ASTM A234 and ASA B16.9.



Lower purchase cost . . . reduction in weight . . . economy and ease in installation . . . increase in flow capacity—these are multiple advantages gained in using Ladish Light Weight Seamless Welding Fittings.

These Light Weight Fittings have been developed and produced under rigid metallurgical and manufacturing standards as part of a continuing program to meet the specific needs of industry for economical, functionally designed fittings.

Specification sheets on Light Weight Welding Fittings and Flanges available on request.



TO MARK PROGRESS

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CUDAHY (Milwaukee Suburb) WISCONSIN

SALES OFFICES: Amarillo • Atlanta • Baton Rouge • Buffalo • Calgary
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SAW BLADES • PIPE FITTINGS • DROP FORGINGS • RINGS • VALVES

LADISH... THE FITTINGS LINE THAT OFFERS COMPLETE SERVICE IN TYPES, SIZES AND MATERIAL SPECIFICATIONS

WELDING
FITTINGS

ASA & MSS
FLANGES

SCREWED & SOCKET
FITTINGS & UNIONS

LONG
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LARGE DIAMETER
& T.E.M.A. FLANGES

KANIGEN[®]

*The proved nickel alloy chemical plating—available only
from General American and its licensees*

KANIGEN is a chemically and metallurgically unique process for applying a hard, corrosion and abrasion resistant surface to most metals. KANIGEN is being used successfully for coating almost everything of any size—from the inside of a tank car to a tiny surgical needle—providing extreme uniformity of coating thickness even on complex shapes. Rack, jig or barrel plating may be used with KANIGEN.

You can rely on General American's integrity and experience and profit from its extensive research and development facilities. KANIGEN, of course, is patented to protect you from imitations.

KANIGEN is a trademark which identifies chemical nickel coating by General American Transportation Corporation and its licensees, the product resulting therefrom and compositions produced by them for use in chemical nickel coating.

KANIGEN is available from General American at East Chicago, Indiana; Sharon, Pennsylvania, and Compton, California, and from licensees in many cities. For further information, call or write.

PHYSICAL PROPERTIES

Specific gravity	7.9
Melting point	1635 °F
Electrical resistivity	approximately 60 micro-ohms/cm/cm ²
Coefficient of expansion	13 x 10 ⁻⁶ cm/cm per °C or 7.22 x 10 ⁻⁶ in/in per °F
Thermal conductivity	approximately 0.0105 to 0.0135 cal/cm sec °C (calculated)
Hardness	as plated—49 Rockwell C heat treatable to 70 Rockwell C

World's largest production facilities for
chemical nickel alloy plating on

Iron
Copper
Aluminum
Titanium
Beryllium
and their alloys

Pilot plant facilities are available for nickel
alloy chemical plating on magnesium, uranium
and non-metals including thermosetting
plastics, glass, ceramics.

Kanigen Division

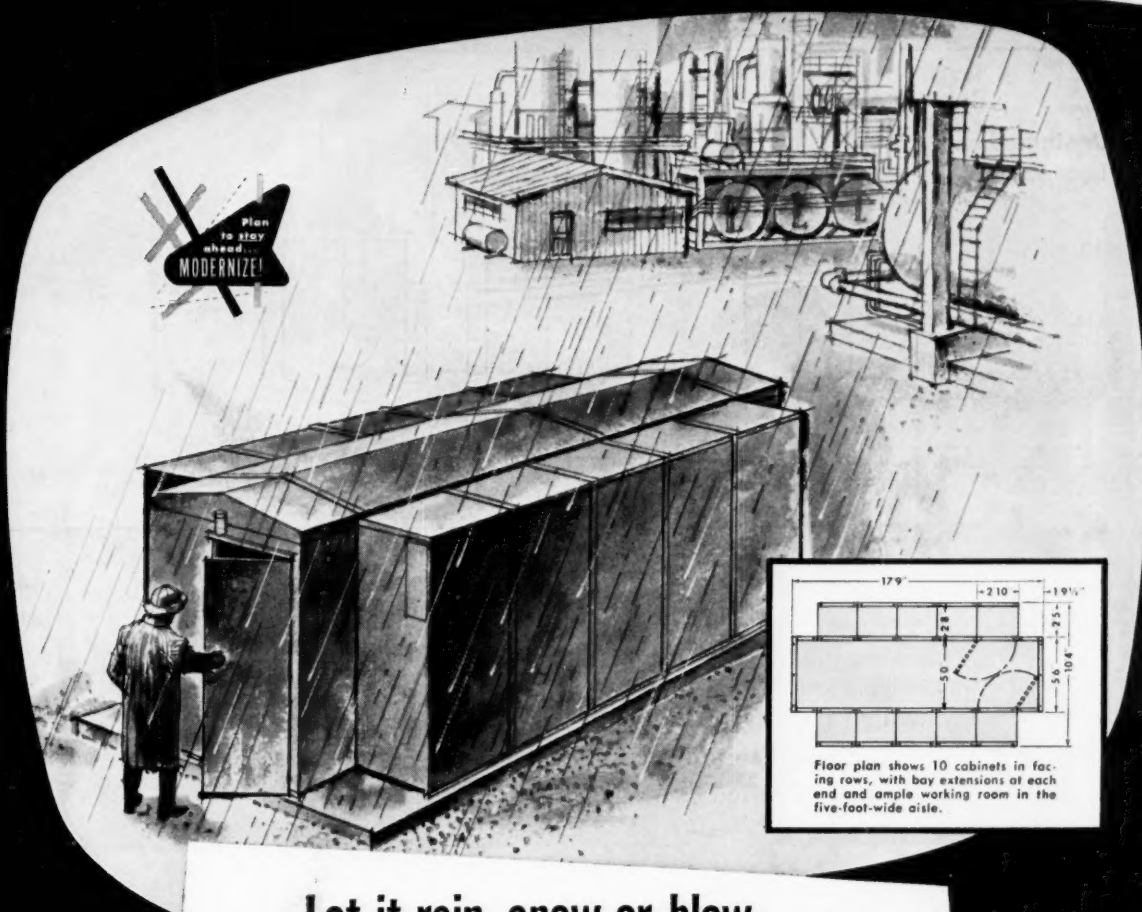
GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South La Salle Street • Chicago 90, Illinois



full SCOPE of
MOTOR CONTROL from...

ALLIS-CHALMERS



Let it rain, snow or blow...

New, Shelter-Clad walk-in enclosures provide complete protection for personnel and motor control

With the new Allis-Chalmers all-steel, walk-in enclosure, you can eliminate expensive, permanent buildings. Your field personnel can carry on inspection and maintenance work in complete safety and convenience, regardless of the weather. *Shelter-Clad* units can even be arranged to provide space for your field office work.

Simple, Flexible Packaged Units

Two facing rows of Allis-Chalmers Type H, 2000 to 5000-volt motor controllers are bridged by a sturdy metal roof with the backs of the control cabinets forming the outside walls. A five-foot-wide aisle, extending the length of the unit, is enclosed with doors at each end. A basic unit can consist of any number of facing cabinets — and any number of pairs of cabinets can easily be added or removed. These units meet NEMA 3 and 4 standards for weather resistance.

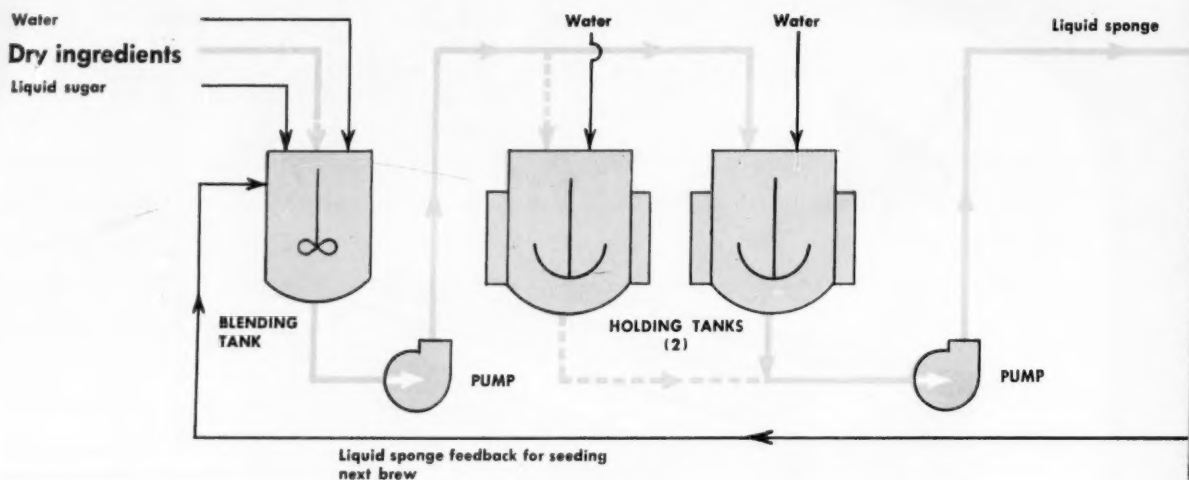
For details, contact the A-C office near you, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

Shelter-Clad is an Allis-Chalmers trademark.



A 5881

PROCESS FLOWSHEET C. S. CRONAN



New continuous route cuts ferment time by

- Controlled feeding of the yeast
- Fermentation in liquid phase
- Recycling fermented "sponge"

Chemical Engineering Updates Dough Making

Deceptively simple is the scientific art of making bread.

Grandmother needed a cup of this, a pinch of that, a strong arm and the assurance that a herd of elephants wouldn't tromp through the kitchen. No longer.

Now, the latest embellishment on the engineering know-how and state of the art is a "liquid sponge" continuous fermentation and mixing process successfully operating at the Fischer Baking Co. in Asbury Park, N. J.

The continuous route contains many interesting engineering features; it shortens ferment time, requires 75% less space than conventional batch systems and needs only two operators.

The process, called Amflow, was developed in conjunction with American Machine & Foundry Co.'s Baking Div., which is now manufacturing the necessary process equipment on a mass-production basis. Fischer's setup has been operating since last October and is turning out 67-100 lb./hr. of bread dough. The entire process takes about three hours.

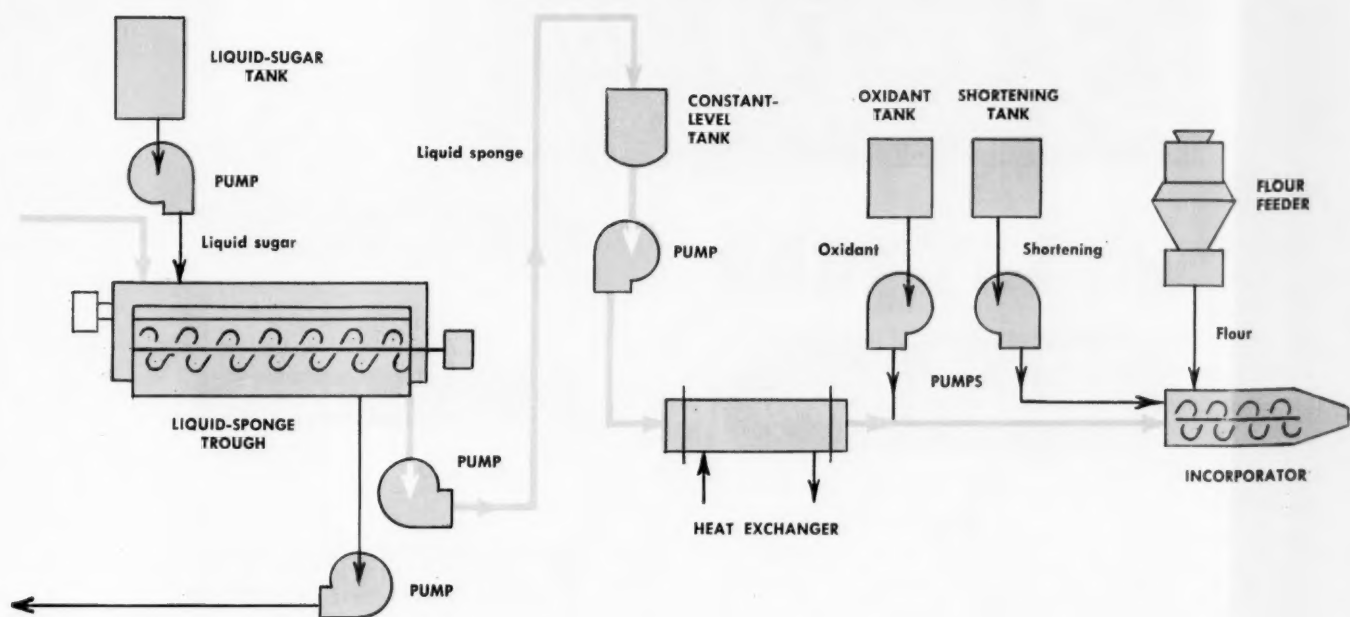
► **Complicated Chemistry** — Ingredients for dough are flour, yeast, yeast foods, salt, milk, sugar, shortening, oxidants, water and enzyme complements. Each of these produces or inhibits a chemical reaction.

Yeast, of course, keys the fer-

mentation process. A living organism, it feeds on simple sugars and converts them, by an imperfectly known mechanism, into carbon dioxide and alcohol. (Fermentation in bread making is known as alcoholic fermentation.)

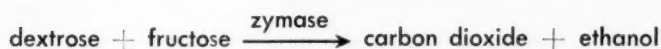
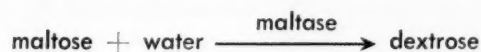
Enzymes, too, play an important part in fermentation. They are biological catalysts. Some enzymes are present in yeast or flour and other enzymes are active as a result of fermentation. It's difficult to distinguish, however, between enzyme action and the result of fermentation (see box, foldout). In the overall process, yeast and enzymes convert flour's starch and proteins into flavor-producing products and

Unfold Flowsheet



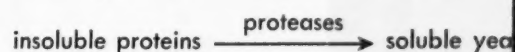
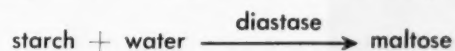
Some Simplified Fermentation Reactions

Enzymes from yeast catalyze these reactions:



All reactions are actually much more complicated and not fully understood. Zymase, for example, produces some glycerine, succinic acid and other flavor-producers.

Enzymes from flour, malt and yeast catalyze these reactions:



Lactic bacteria, present in flour, convert dextrose to lactic acid by fermentation.

Yeast foods often contain ammonium chloride. It's believed that baker's yeast (of the species *Saccharomyces Cerevisiae*) converts these to sulfuric and hydrochloric acids.

gluten, which forms the plastic structure of dough.

► **Some Innovations**—AMF points to notable differences between the Amflow "liquid sponge" continuous process and other processes.

Ferment time is shortened by controlling yeast feeding and recycling some liquid sponge (containing lactic bacteria and late-forming, flavor-producing enzymes) to seed the original brew. By adding all the yeast and only some sugar and yeast food in the original brew, Amflow accelerates yeast to optimum high activity.

Fermentation temperature is higher than in conventional processes. In water-jacketed tanks temperature is held at 86-90 F., compared with 75-85 F. in other

methods. This maintains yeast at high activity.

In mixing operations, Amflow process uses higher-than-atmospheric pressures—as high as 50-60 psig. in one step. This forces carbon dioxide into a finer cell structure within the dough.

► **From Brew to Dough**—Initial ingredients (yeast, nutrient mix, water) pass through three main physical stages on their way to becoming bread dough. In the blending tank (operating capacity, about 150 gal.), they are called a "brew." Here a specially made double-cone blender keeps the brew homogeneous. Fermentation is aided by relative speed of mass transfer in a liquid phase.

After about an hour, salt, milk

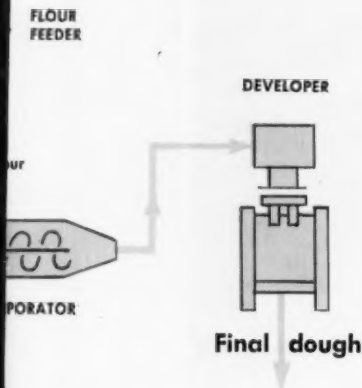
and 10-16% of the flour are added and the mix is pumped to one of two holding tanks (operating capacity, about 250 gal.) to develop liquid sponge, which is about the consistency of a high-solids milk. The rest of the water is added here. A four-pronged horseshoe agitator holds flour in suspension while fermentation continues.

From the holding tank, the sponge is pumped to a horizontal liquid sponge tank where more sugar is added to make sure there's unfermented sugar in the final dough. Fermentation continues here for about an hour, while liquid sponge is agitated mildly with paddles and baffles. On leaving the trough, the sponge has completed fermentation.

► **Mixing Is Thorough**—The liquid sponge, at level tank passes through a heat exchanger to preheat its temperature. The heat generated in the process at this stage is used to preheat the flour.

Oxidant (potassium iodate) and vegetable oil are added, along with yeast food to develop gluten. The mixture is placed in an incorporator with a variable-pitch agitator which mixes the mass (at 2-5 psig.) into a uniform mass called the premix.

Premix then goes to a dough developer where conical paddle-blades knead the mass (at 50-60 psig.) into properly finished dough.



Yeast catalyze these reactions:

→ maltose

→ soluble yeast food

Flour, convert dextrose to lactic

ammonium chloride and sulfate.

It (of the species *Saccharomyces* sulfuric and hydrochloric acids.

► **Mixing Is Thorough**—A constant-level tank passes the liquid sponge through a heat exchanger to lower its temperature so it can absorb heat generated in mixing and leave the process at the right temperature.

Oxidant (potassium bromate or iodate) and vegetable shortening are added, along with flour, to help develop gluten. This step takes place in an incorporator fitted with a variable-pitch screw conveyor, which mixes materials (at about 2-5 psig.) into a homogeneous mass called the premix.

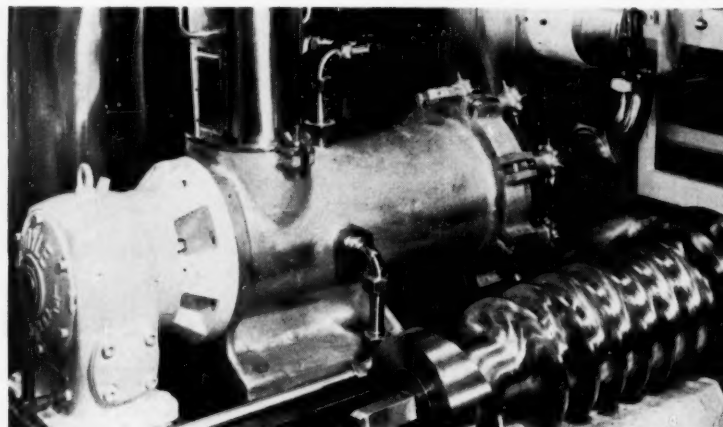
Premix then passes to the developer where counter-rotating double-arc paddles shear and stretch the mass (at 50-60 psig.) into a properly finished dough.



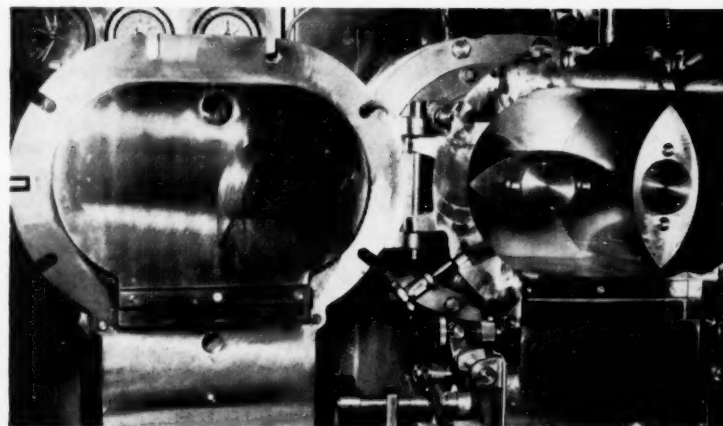
BLENDING AND HOLDING TANKS mix ingredients and keep brew agitated. Four-ft.-dia. blending tanks are water-jacketed.

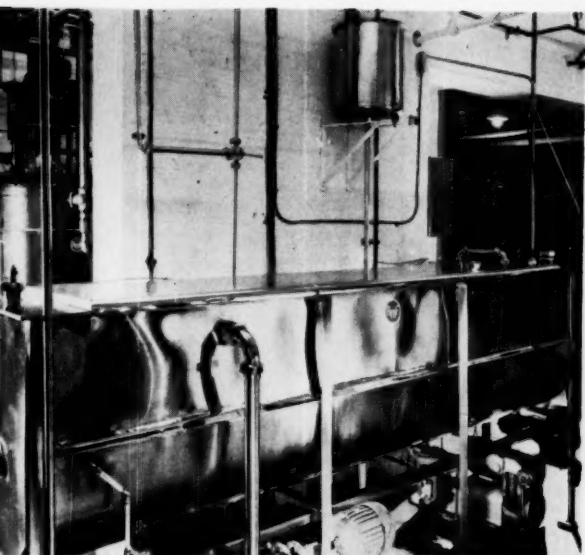


LIQUID tion. T

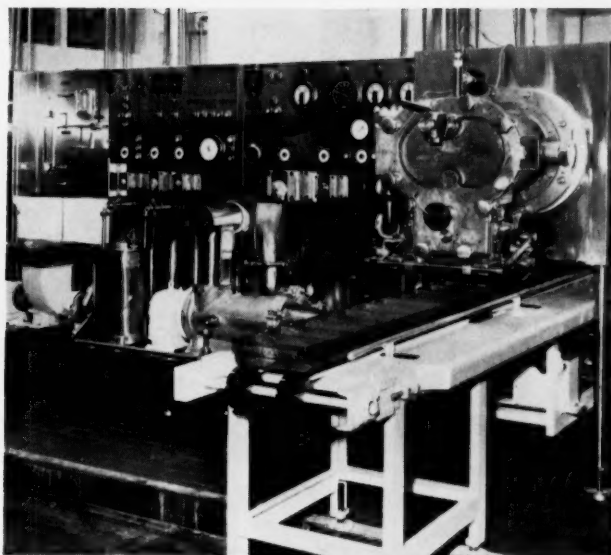


INCORPORATOR, disassembled, shows the specially designed variable-pitch **DEVELOPER** interior shows counter-rotating paddles which operate at 50 to 200





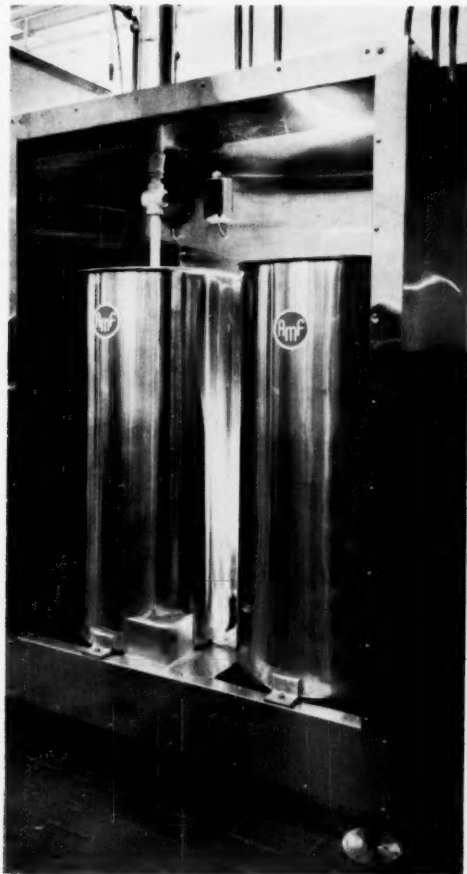
LIQUID SPONGE TROUGH is third and last step in fermentation. Trough is 10 ft. long, with operating capacity of 250 gal.



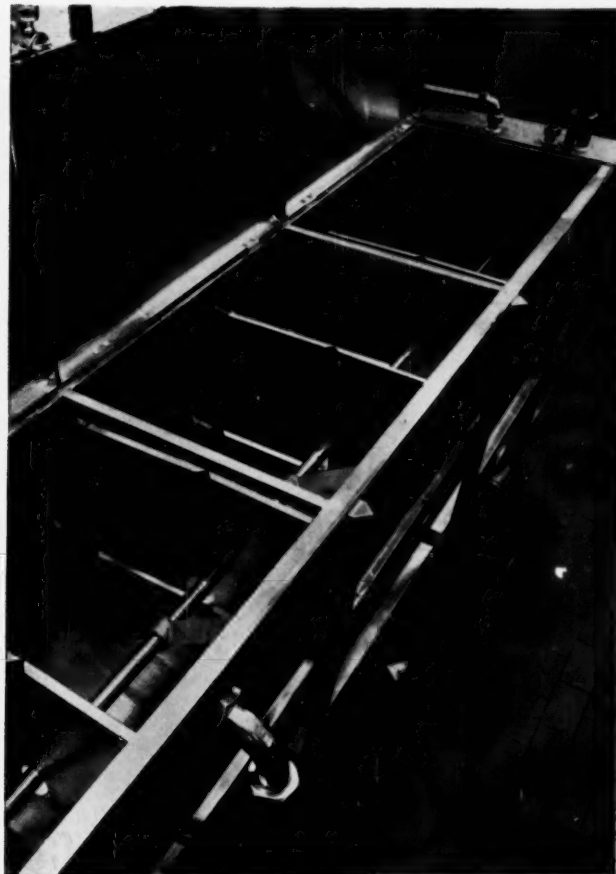
MIXING SYSTEM shows incorporator (center, beneath control panel), developer (right) and, below it, divider-panner.



pitch screw.
to 200 rpm.



SHORTENING AND OXIDANT TANKS are behind control board. Each has 70-gal. capacity.

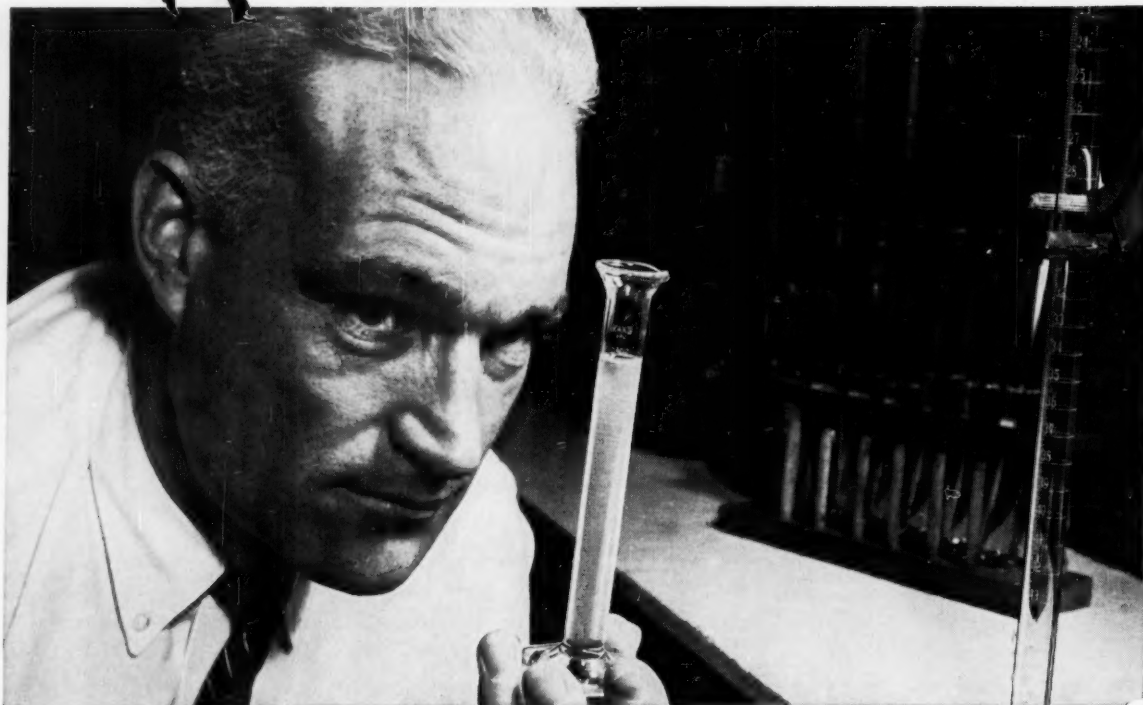


LIQUID SPONGE TROUGH interior shows curved-angle blades which revolve slowly to provide proper agitation for sponge.



BRIDGEPORT "T" MEN* IN ACTION

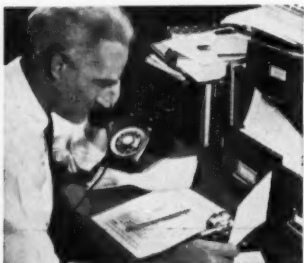
*Technical Service Men



The Case of the Acid Assailant



Where's the Culprit? Field spot tests of water samples give revealing clues as to cause of corrosion.



Case Solved. Initial recommendations go out to customers immediately and are followed by a detailed written report.

It was an ordinary afternoon in the Corrosion Lab when a sample of raw cooling water and a corroded condenser tube arrived from a midwest chemical company. Accompanying the evidence was a letter of explanation and a completed Technical Service corrosion questionnaire. The customer wanted help. Bridgeport "T" men swung into action.

The water sample was analyzed. It checked out against the original sample taken when Bridgeport tubes were first installed. Still no conclusive evidence of corrosive media was found in the water. Yet, examination of the tubes revealed them to be corroded both by acid and an abrasive.

The Bridgeport "T" Man visited the plant site and retraced the case step by step.

The first break came when a spot check was made of water taken directly from the cooling tower. A significant acid content

was noted. Further on-the-spot examination showed that gas and fly ash from the plant smokestack were carried by prevailing winds over the cooling tower and deposited in large amounts in the tower. Closer examination of the cooling tower uncovered acid-forming sludge and abrasive fly ash in suspension.

The Bridgeport "T" Man, in an extensive report of his findings, recommended corrective measures. Company adopted recommendations. Tubes saved. Case closed.

This is a typical case from the files of Bridgeport Technical Service, a group set up to help Bridgeport customers get maximum life and service from their power and process equipment.

For the best service and advice on condenser or heat exchanger tubes call your nearest Bridgeport Sales Office today.

Dept. 5002

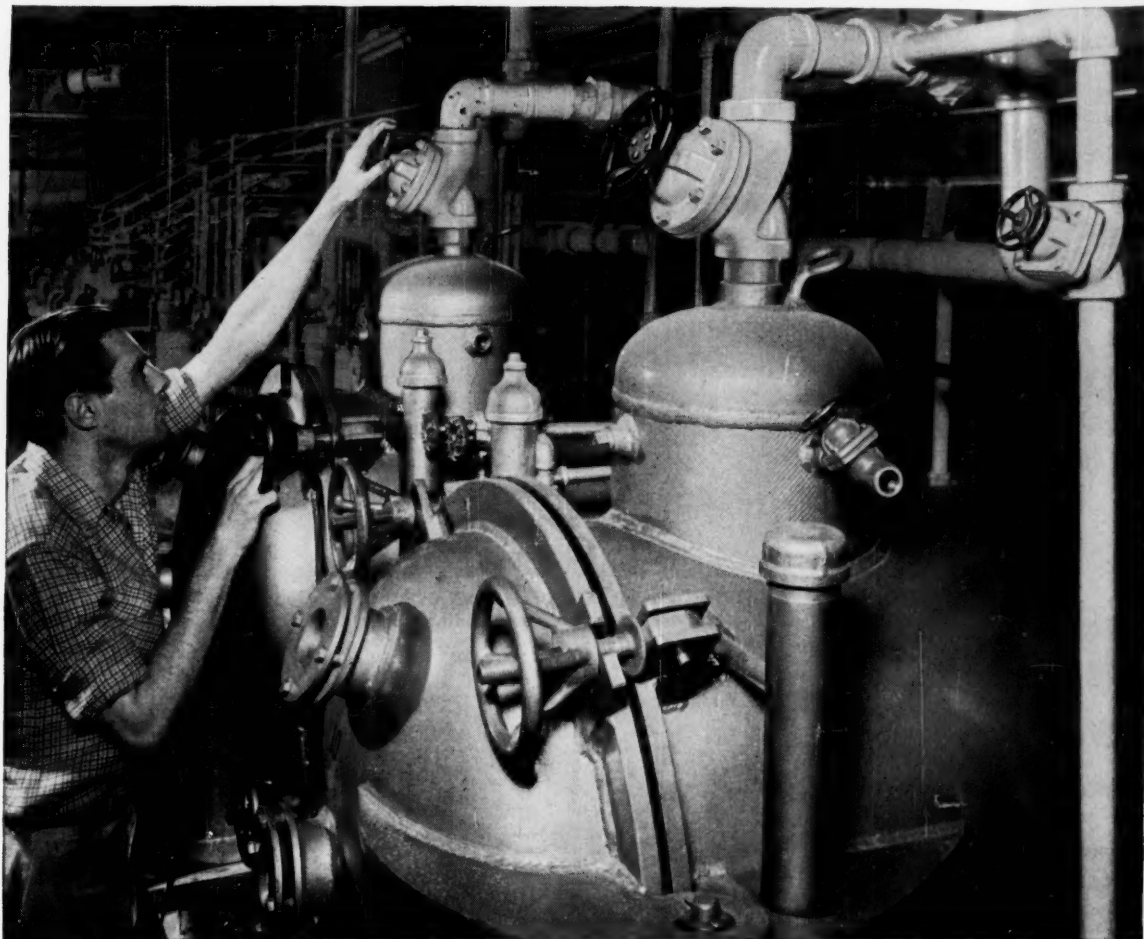
BRIDGEPORT CONDENSER TUBES



Bridgeport Brass Company, Bridgeport 2, Connecticut

Sales Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal

Packless valves assure Electron Products perfect processing



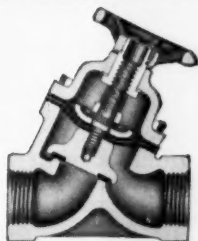
Crane diaphragm valves still hold tight after 18 months on 100-micron vacuum service

Electron Products Inc., Pasadena, Calif., forms special electronic parts of metalized paper. Processing—drying, deaerating, impregnating—is done under constant vacuum.

Valves, to hold the critical vacuum within a maximum leak rate of 100 microns for a 24-hour period during processing, had to be selected with care. Obviously not any valve would do. The choice—Crane diaphragm valves for high performance value.

After 18 months, these Crane packless valves continue to hold tight on this critical vacuum service for as long as 36 hours—and on occasion, over an entire weekend.

Crane packless diaphragm valves are widely used also in processing industries where absolute tightness is necessary to prevent leakage of volatile, corrosive and hard-to-hold fluids. Complete information available from your local Crane Representative, or write to address below.



Cross section, Crane diaphragm valve—note diaphragm seals the bonnet only, separate from disc function. It is not subject to severe flexing, crushing and abrasion as in valves where diaphragm does both jobs.

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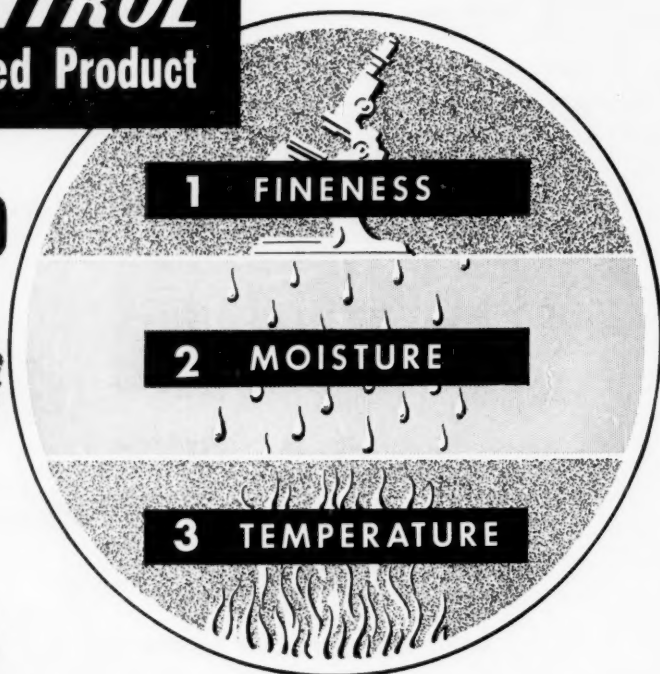
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RAYMOND IMP MILL

equipped with Flash Drying Accessories for removing moisture while pulverizing the material.

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The resulting economies can well become an important factor in your profits of production. The complete Raymond unit provides a clean, dust-free system—easy to install and operate—automatic in handling the material from feed hopper to finish bin—with close control over quality.

Fineness of classification over a wide range is easily regulated by a single exterior adjustment of the Whizzer Separator while mill is running.

Moisture is removed during the process, and the final content is controlled within close limits.

Temperature is reduced to the proper degree for bagging or storage by passing the fine material through a cooling system.

If you are making fine chemicals, pigments, washed kaolin, synthetic resins, phosphate materials, and powdered foods or similar products—let Raymond engineers help you solve your production problems.

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Cherry-Burrell Superhomo Homogenizers keep Lady Esther Cream smooth and creamy. C-B's high speed shearing action cuts fat globules down to equal size. Steady pumping pressure disperses them thoroughly through the cream. Eliminates any chance of oil separation, any return to the prehomogenized

state. Lady Esther never disappoints its millions of lovely customers.

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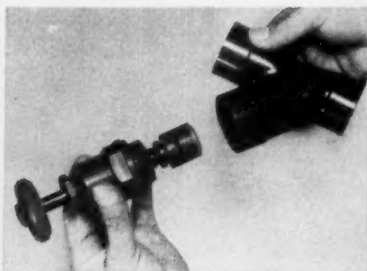
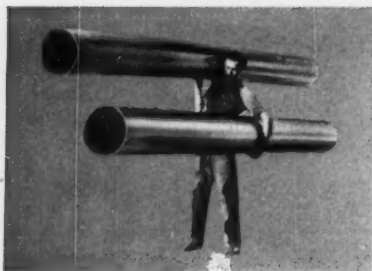
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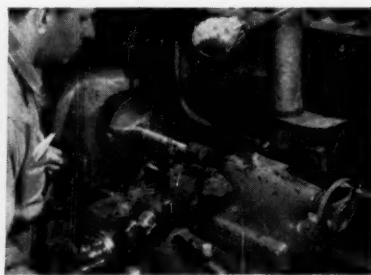
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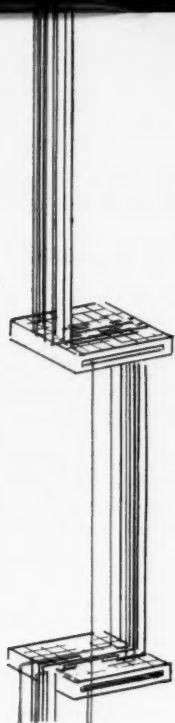
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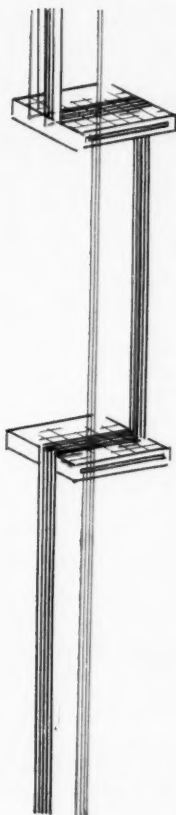


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When you specify sieves . . .

Include Screen Opening Size



For desired particle size and maximum throughput in sifting equipment, emphasize screen opening as well as mesh.

STANLEY A. GOLDBERG and WARREN WALTER
Sprout, Waldron & Co., Inc., Muncy, Pa.

BASIC purpose of any screening operation is to separate a given product into specified particle sizes. Hence, we may be concerned with all particles over or all particles under a stated dimension. In this case our separation is a single and relatively simple one. Most of the time we are interested in a particle size range with upper and lower dimensional limits. In either case, the objective is clear but until we have certain qualifying factors, the approach to the problem is subject to a great deal of ambiguity.

The reasons for the ambiguity are tied to the fact that the same words mean different things to different people. Desired particle dimension is usually specified in terms of mesh size. Unfortunately, this term means very little and its use is the major cause of the confusion.

Each manufacturer of bolting cloth uses his own numerical designation for these cloths and generally numbers them in accordance with mesh openings per lineal inch. There are two commonly used standard mesh opening designations, the Tyler Standard and the U. S. Standard series. These two standards were developed using different mathematical considerations for the size progressions. As a result, they differ from each other so that different index numbers actually refer to identical mesh openings. This difference is one major source of difficulty.

Another difficulty is the variation in sieve openings for the same mesh designation. For example: the term 16-mesh covers a lot of ground. In the table on the next page, we show some of the variations which meet the commercial designation 16-mesh. Note

Opening Varies for Same Mesh Size

Commercial 16-Mesh Designation	Sieve Opening, in.
Tyler tinned mill screen (TMS).....	0.0465
Tyler Durloy and stainless steel bolting cloth...	0.0535
Bodmer G. G. Gritz.....	0.0582
Bodmer XXX G. G. Gritz.....	0.0600
Bodmer standard silk and XXX silk bolting cloth	0.0034
Bodmer X silk	0.0032
Tyler standard	0.0390
U. S. standard	0.0469

that the table shows eight designations each of which answers to the qualifying term 16-mesh; yet in each case the mesh openings differ in size. In some cases the differences are relatively small, in others relatively large.

The important thing to remember is that in specifying a product as 16-mesh, we can conceivably get a wide range of product size. This same multiplicity of meanings for an identical term does not apply only to the 16-mesh size but is common for all mesh sizes encountered in commercial sifting cloths.

For example, The W. S. Tyler Co. specifies in its handbook 18 different 16-mesh woven-wire cloths of brass, copper, bronze, phosphor-bronze, Monel, nickel and stainless steel in addition to the three Tyler 16-mesh cloths given in the table. All of these cloths have 16 openings per lineal inch which gives them the right to be called 16-mesh cloths.

However, the openings themselves vary from a size of 0.0215 in. with an open area of 11.8% to a size of 0.0530 in. with an open area of 71.9%. Although the mesh designation refers to the number of openings per lineal inch, the actual size of the opening is determined by the gauge of the wire. Without knowing the gauge of the wire, there is no way of determining the actual size of the opening which is really the governing factor in any screening operation.

To explain the variation more clearly and in an exaggerated way, let us assume that we have 16 openings per lineal inch and use a wire diameter of 0.0624 in. For this screen, our actual openings are only 0.0001 in. or one-tenth mil. For practical purposes, such an arrangement is ridiculous since this screen will have an open area of 0.00026%. The exaggeration serves to illustrate how meaningless and ambiguous the term 16-mesh can be when used by itself.

Testing laboratories are often faced with this ambiguity when asked to run sifting tests and recommend sifting equipment for specific problems. In attempting to get our own sales people and customers to be more specific we are often told that the equipment presently in use is of an old design and the actual designation of the sifting cloth has been lost. In other words, the commercial designation is no longer available. Hence all they do is count the number of openings per lineal inch in the sifting screen.

A great deal of time and empirical testing may be avoided if micrometer measurements were taken of the wire in addition to counting the number of openings per inch. Where it is not feasible to get the wire diameter on the spot, a sample of the actual sifting cloth

should be forwarded with any request. Most laboratories are equipped with sieve counting instruments.

Why Open Area Is Important

Let us look a bit more closely at the importance of the percentage of open area. An extreme case of reduction of open area while maintaining the same mesh count has been given previously. It is now evident that by varying wire size, we can get almost the same opening size in a 40-mesh screen as we get in a 48-mesh screen.

The effect of open area on screen capacity can be appreciated by drawing an analogy to the rate of flow of a liquid through a 4-in. valve with the gate just cracked open compared to the rate which could be obtained for a 2-in. valve in a wide open position under the same pressure conditions. In other words, it is the amount of open area as well as the number of openings per inch which determines the capacity which can be put through a given screen.

A good example of screen capacity is shown by the results of a recent laboratory test on polystyrene resin. The material to be tested contained approximately 11% plus 40 (retained on 40-mesh) U. S. Standard sieve fraction. The opening on U. S. Standard 40-mesh sieve is 0.0164 in. Tests were made on 48-mesh Durloy bolting cloth which has an opening of 0.0163 in. and an open area of 61.5% and on a 40-mesh TMS screen having an opening of 0.0165 in. and an open area of 43.6%.

Let us compare the screen areas necessary to obtain a yield of 88% of the minus 40 U. S. Standard sieve fraction. The term minus 40 mesh means passing through the 40-mesh screen. For a 2,000 lb./hr. resin input to the sifter, a theoretical screen area of 22.3 sq. ft. is necessary when using the 48-mesh Durloy screen or 29.6 sq. ft. for the 40-mesh TMS screen.

The direct relationship between open area and screening capacity can be seen if the proportions of screen area requirements versus available open area are equated to each other. For the two screens used in the test, the ratio for the open areas is 61.5%/43.6% or 1.41. For the same screens, the ratio of screening capacities is 29.6 sq. ft./22.3 sq. ft. or 1.33. For all practical purposes, these ratios agree almost exactly. Placing the emphasis on open area percentage instead of mesh count can very often result in increased capacity from the same equipment.

Another case, which indicates larger capacity for the same opening is a test run on wood flour. A sifter using a cloth with 48.3% open area handles an input of 1,400 lb./hr. Changing to a bolting cloth with the same mesh size but having 69.7% open area increases the capacity to 2,000 lb./hr.

The two examples seem to indicate that all we do to increase the capacity of a given sifter is to increase the open area. We accomplish the increase in open area by selecting a screen with finer wire diameter.

It is important to recognize at the outset that there are definite limitations to increasing the open area. These limitations depend mainly upon the mechanical load which we put on the sifting equipment. For any given rate of flow and given bulk density, there must be a limit to the fineness of wire provided in the sifting equipment. This limit will be based on the tensile strength of the wire and the load imposed on the

screen. Excessive loading in terms of strength of the wire means excessive screen replacement costs. These costs may often overcome any savings resulting from increased capacity.

How to Specify Sieve Sizes

A specification reading "the material must be of No. 16 U. S. Standard sieve size," technically speaking, implies that each particle must have a diameter of 0.0469 in. Speaking practically, it means either that the material must all be of No. 16 U. S. Standard sieve or must all be able to pass through the same sieve.

It is important that the actual requirement be stated so that there is no confusion in terms of meaning. Particle size should always be stated in terms of a range, or a size grouping which falls between two standard sieve sizes. To avoid confusion, the specification should read "100% through No. 8 U. S. Standard sieve and on No. 16" or "100% through No. 16 U. S. Standard sieve and on No. 20."

It should be understood that the closer the maximum and minimum particle sizes of a cut are set, the larger will be the screen area required for sifting. Conversely on any specified amount of sifting area, the smaller will be the yield of in-range product.

It is conceivable that classification equipment to secure a product "through 14 and on 16" may cost a great deal more than equipment sized to deliver a "through 14 and on 18" product for the same percentage yield of material per unit time. For reasons of economy, it is always best to consider the widest particle size range when seeking sifting equipment.

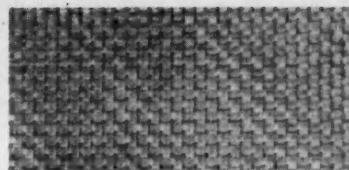
Another important factor in sifter design and consequently in capital investment for a desired product is the variable known as "cleanliness of cut." This term means how much material outside of the specified size range will be allowed in the finished product.

The more severely the amount of oversize in the product is restricted, the closer the openings in the sifting cloth must approach the specified particle size. The resultant reduction of the opening reduces the rate of bulk flow through the cloth and results in a larger screening area for a specified rate of input. It is safe to say that a cut which allows only 0.5% of material larger than the specified particle size requires 30 to 50% more screening area than a cut which allows 5 to 10% of oversizes in the product.

Also to be considered is the yield of a desired product. The example of sifting polystyrene resin cited previously demonstrates the effect of open area on sifting capacity. Using the recommended screens and the stated screening area, the yield is 88% of the cut actually available in the feedstock. In determining the required yield, there is the necessity of evaluating the cost or value of the product against the capital investment required for sifting.

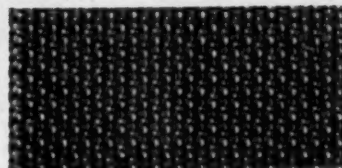
Ordinarily in the yield range past 85 to 90%, the amount of screening area necessary to get out the last fraction of in-range material increases rapidly. The major reason for this increase is that in a random distribution pattern, a large amount of the in-range product is appreciably smaller than the maximum particle size specified.

When the through-put of these relatively small particles is completed, the particles which are larger but still fall under the specified size remain to be sifted.



14 mesh

0.054 in. opening



14 mesh

0.030 in. opening

Basis for Standard Sieves

► **Tyler Standard Series** starts with the 200 mesh sieve which was established originally as a minimum for commercial screens. This sieve uses a 0.0021 in. wire diameter which gives a sieve opening of 0.0029 in. With this opening as a base, the width of each successive larger opening is exactly the square root of two times the previous opening. The original Tyler screen scale covers the following meshes per lineal inch: 3, 4, 6, 8, 10, 14, 20, 28, 35, 48, 65, 100, 150 and 200.

After the standard scale was arranged an intermediate series was developed to include openings for closer sizing. The openings per inch for this intermediate series are such as to give opening sizes the fourth root of two times the finer opening.

► **U. S. Standard Series** follows the same square root of two relation as the Tyler Standard series but uses an opening of one millimeter as the base. However, trying to maintain a metric scale for the full range of openings while retaining the mesh per inch designation requires odd wire diameters.

By establishing a range of permissible wire diameters for each sieve opening, a compromise between mesh per inch designation and opening in metric units was found.

Using this range of permissible wire diameters, the U. S. Standard series eventually included all the Tyler Standard sieves but with slightly different mesh designations for some of the sieve openings.

Further since sifting through a sieve is a random matter, these larger particles in moving about the screen tend to strike more wires per unit movement than the smaller ones. Consequently, these larger particles require a greater amount of screen area before passing through.

As a result, the increase in screen area necessary to

pass each succeeding percentage over 85 to 90% becomes inordinately large. In many cases 50% or more additional screen area is required to approach 100% yield. The consideration for yields greater than 90% becomes chiefly the amount of capital investment versus the cost of in-range material which will not discharge with the cut.

Other Factors to Consider

Regardless of similarity in sieve analysis, our Experimental Department finds that different materials require completely different sizes and styles of sifting equipment for any particular job. Basic differences in the materials make necessary the variety of equipment. Let us look at some of these differences.

First consider the size and shape of the particles. If the material to be sifted is made of regularly shaped particles such as spheres, screening is a relatively simple operation. In a single pass the particles will either be accepted or rejected by the opening sizes of the wire mesh.

When particles are of irregular shape, the position of the particle in relation to the screen openings will often determine whether or not it passes through. Many particles are of such size and shape that there may be only one position in which they will actually pass through the opening. Therefore, to effect a perfect separation all of these critical particles must be made to assume all of the different positions so they will eventually pass through the sieve.

Although the majority of material may be shaped or sized so as to be immediately rejected or accepted, the odd-size particles present the critical problem in sifting. This is particularly important in cases where the

sifting is done to very close specifications and must be considered seriously before selecting sifters.

Compaction or density of a bed of material is significantly related to the freedom of flow in the mass. The more compact a bed of material becomes, the more difficult it is for general flow in the bed to occur. For the most part, flow can not occur without constant changes in the relative positions of each particle to its neighbor. In a highly compressed or compacted state, the voids are already filled. These voids might normally be large enough to provide a new position for each disturbed particle. Therefore, the compacted bed is relatively immovable.

An ideal condition for solids flow is one which provides a large percentage of voids not much smaller than each particle in size. As the material departs from this ideal state, the flow problem becomes more critical and requires a larger amount of sifting area for complete flow over the mesh openings. Hence feed rate to the sifter must be carefully considered in the light of shape, bulk density and other characteristics of the material.

If the material is electrostatic in nature, mass build up on the screen causes blanking of the holes and consequently inefficient sifting. Many cases have been noted where small particles which ordinarily fit through the sieve opening have been attracted to larger particles. The small particles then carry through the overs-channel thereby reducing both the yield of the throughs and the cleanliness of the overs.

Agglomeration due to electrostatic charges can either blank the screens or cause small particles to pass along with the overs. In each case the result is lower yield and less clean cuts.

Materials having low bulk densities and a tendency to fluff such as wood flour and cork are very often difficult to sift. Aeration in progressing from sieve to sieve causes this difficulty. When sifting materials of this type, it is important that sifter construction provide a maximum of free area for passage of materials through channels and beneath screens. Entrained air encourages the material to float above the screens. As a result, efficiency is reduced.

In many cases, these variables require equipment design completely different from what is commonly considered standard. To accomplish specific results, it is necessary to alter the rate of rotation, the circle of gyration, the type of grounding and anti-static agents. Also, it may be necessary to incorporate mechanical cleaners and other devices to provide additional agitation to individual screens.

In summation, we would like to emphasize that to get best results it is important to determine first what is needed and then specify it properly.

Always give: (1) sieve standard, U. S. or Tyler; (2) commercial sieve used on existing equipment if results are satisfactory, or openings per inch and wire size, or sample of the cloth for measuring at testing laboratory; (3) particle size as a range between two standard meshes.

It is also important to recognize that:

- Although materials may appear similar and have similar sieve analysis, different materials do not necessarily show similar sifting characteristics.

- The narrower the range and the cleaner the cut desired, the lower the yield per unit sifting area and the higher the cost of sifting.



Stanley A. Goldberg



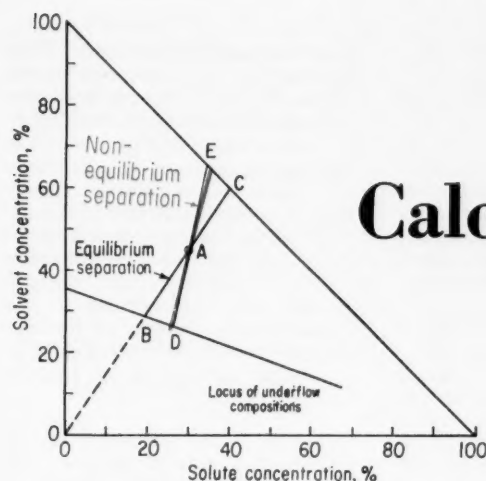
Warren Walter

STANLEY A. GOLDBERG is manager of the Experimental Department of Sprout, Waldron & Co. He received his B.S. degree in Commercial Chemistry from Pennsylvania State University and continued with graduate studies at Brooklyn College.

He is a member of the Pennsylvania Society of Professional Engineers.

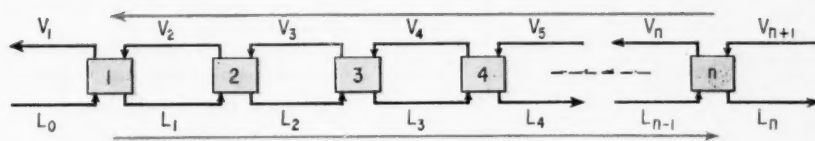
WARREN WALTER is chief product engineer in the Size Classification Department of Sprout, Waldron & Co. Walter joined Sprout-Waldron in 1955 as a Draftsman in their Engineering Department and in 1957 was promoted to his present position.

Mr. Walter attended Pennsylvania State University.



For Non-Equilibrium Leaching...

Calculate No. of Stages Graphically



WENDELL J. GEORGE, Wyandotte Chemicals Corp., Wyandotte, Mich.

THE TERM "leaching" is usually applied to liquid-solid extractions. In general, this unit operation consists of the removal of one solid (the solute) from another (the inert) by contacting with a liquid (the solvent).

Calculation of leaching problems would be simple if the solvent with the dissolved solute could be completely removed from the inert. This is only true if adsorption effects are absent; in which case only one extraction step is required, and the solvent necessary is that sufficient to dissolve the solute.

The separation of inert and solution is usually not so simple, however. This separation can be performed by a settling period followed by decantation of the supernatant liquid, filtration, centrifugation or any other suitable method. In such operations the solution is not completely removed.

Methods have been presented to handle countercurrent leaching where the solution retained by the solids has the same solute concentration as the bulk of the solution. When adsorption or other effects are present, the calculations are not as simple and fewer solutions to this type problem are in the literature.

We will give a relatively simple

method of calculating extraction problems where adsorption or other effects play a part.

Other Calculation Methods

In the main, past calculation methods for countercurrent leaching problems have been based on the assumption that equilibrium is attained in each stage. This is the same as saying that the solution left with the solid has the same concentration as the bulk of the solution.

Graphical methods of Raven-croft,¹² Tsao,¹³ Elgin⁶ and Ruth¹⁴; and analytical methods by Badger and McCabe,⁷ Baker⁸ and Haley,^{9,10} are for extraction problems based on the above assumption.

In many instances, however, this assumption of equilibrium is not true. For example, if the solid tends to adsorb the solute or retards solute diffusion into the liquid, then the quantity of solute left with the inert will be greater than if equilibrium had been attained.

Generally, design calculations for this situation are made by assuming equilibrium conditions and correcting for the actual number of stages required by using the concept of over-all stage efficiency. In this case the actual number of stages re-

quired must be determined by laboratory countercurrent extraction, simulating the larger scale conditions.

Several methods of calculating liquid-solid extractions for non-equilibrium conditions are in the literature. Graphical methods have been suggested by Kammermeyer and Armstrong¹ and Schiebel,¹⁴ while an analytical method has been described by Grosberg³ for such conditions.

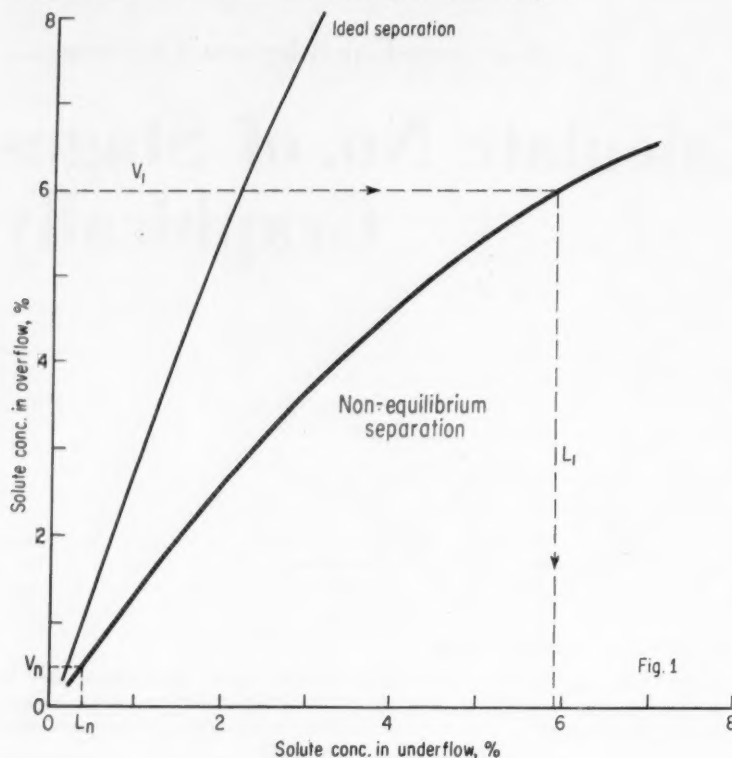
In general, these methods lack the ease of Elgin's triangular graph material balance procedure for equilibrium calculations. A modification of Elgin's method presented here for non-equilibrium situations gives the same ease and clarity of the graphical material balance method.

Treybal¹⁵ presented a method very similar to the one here using rectangular coordinates instead of triangular coordinates. The use of triangular coordinates has a distinct advantage in that stream concentrations are represented directly on the diagram, which gives clarity to the interrelationships involved.

How to Calculate Graphically

Since the extent of adsorption or diffusion of the solute is a function

Experimental Data Form Basis for Leaching Design



of the particular system of interest, experimental data will be necessary for any given system.

An adequate description of the Elgin method has been presented in several references^{4,5} and so no details of this method will be presented here.

The non-equilibrium condition can be represented on a triangular graph as shown on the introductory diagram. If a slurry of concentration A were separated into underflow and overflow streams under equilibrium conditions, then by drawing a line through point A and the origin and extending this line to the hypotenuse of the triangle, points B and C would represent the overflow and underflow concentrations from this separation.

If non-equilibrium conditions were to be represented on this diagram, the underflow would contain more solute than at point B and would have a composition to the right of point B , say at point D . The overflow concentration would then be determined by the intersection of the hypotenuse with the

line drawn through points A and D . It is evident that the extension of this line cannot go through the origin of the triangular plot.

By preparing a number of slurries with various amounts of solute present and then separating the overflow and underflow, it is possible to determine both the locus-of-underflow-concentrations and also the relation between the overflow concentration and underflow concentration. Fig. 1 shows typically the overflow solute concentration.

These data can be represented in several ways but this method has the most utility. As shown in this figure, for a given overflow solute concentration, the underflow solute concentration is lower under equilibrium conditions than under non-equilibrium conditions.

The separation of slurry into overflow and underflow can be carried out in any conventional manner—filtration, centrifugation or settling. The particular method used will affect the location of the locus-of-underflow-concentra-

tions and also the position of the equilibrium and non-equilibrium curves, but both curves will have the same relationship to each other.

Data as shown in Fig. 1 would be the type necessary to determine the exact non-equilibrium conditions for any particular system.

Using the schematic flow diagram on p. 111 for the countercurrent liquid extraction system, the difference point concept can be discussed briefly. An over-all material balance written for this system is

$$\begin{aligned} D &= V_1 - L_0 = V_2 - L_1 \\ &= V_3 - L_2 = V_{n+1} - L_n \end{aligned}$$

where D is the difference stream between any pair of streams, such as V_3 and L_2 . This difference stream represents the "net flow" of material to one end of the system at all points in the system.

Component material balances can be written also for component A :

$$\begin{aligned} (Dx_A)_D &= (Vy_A)_1 - (Lx_A)_0 \\ &= (Vy_A)_2 - (Lx_A)_1 \\ &= (Vy_A)_{n+1} - (Lx_A)_n \end{aligned}$$

where x and y are fractions of the component present.

It has been assumed that D is positive when V_1 is greater than L_0 , so that D and $(x_A)_D$ can both be negative in those cases where L_0 is greater than V_1 . Identical equations and statements can be written for any component.

The location of the difference point in the graphical method of calculation is determined by the over-all material balance. Thus, the location of the difference point is not a function of whether or not equilibrium is attained in each stage. That is, V_2 and L_1 have a relationship to each other, determined by an over-all material balance, regardless of the relationship of V_1 and L_0 . The location of the difference point does not depend upon having the solution which adheres to the inert equal to the solute concentration in the bulk of the solution.

This important concept means that the difference point can be located in the same manner for non-equilibrium cases as for those involving equilibrium. Then essentially the only difference in the graphical material balance for the two conditions is in the relation between the overflow and underflow compositions.

By combining the information in Fig. 1 with the graphical material

balance method, the solution of non-equilibrium extraction problems can be handled as easily as those under equilibrium conditions. This will be illustrated in the following problem.

Problem Illustrates Method

Determine the number of stages required and solvent required for the removal of solute A from the

feed F . The feed will be 30% solvent, 14% solute and 56% inert. The inert product L_n will contain 99.5% inert on a dry basis and the final overflow V_1 will contain 6% A. Non-equilibrium conditions will hold, and Fig. 1 represents the relationship between the overflow solute concentration and the underflow solute concentration. It is assumed that the locus-of-underflow concentrations is as shown in Fig. 2. Pure solvent (V_{n+1}) will be used in the extraction.

The solution to this problem is shown in Fig. 2. The feed, underflow product, overflow product, and solvent are indicated by points F , L_n , V_1 , and V_{n+1} , respectively. The solvent required for this can be

determined quickly by connecting L_n and V_1 and V_{n+1} and F . The intersection of these lines is commonly called the J point. The ratio of solvent to feed is given by the ratio of line lengths—in this case, 2.15.

The number of stages required is now determined in a similar manner as for equilibrium conditions. The solute concentration in the underflow is determined from Fig. 1 at an overflow solute concentration of 6%. This line is shown as V_1-L_1 . Obviously this line does not go through the apex of the triangle. The line from V_1 to the apex represents the condition when equilibrium conditions hold, where the underflow concentration in this case would be L_1^* .

To determine V_2 , the difference point Δ and L_1 are connected. The intersection of this line with the hypotenuse is the composition of V_2 . Underflow L_2 is located using Fig. 1 in the same manner as for L_1 . The construction is continued until the composition L_n is reached on the underflow line. In this case, the extraction takes three stages.

In the laboratory using the same solvent to feed ratio, three stages were found to be sufficient to pro-

Step Off the Actual Number of Stages on Triangular Graph

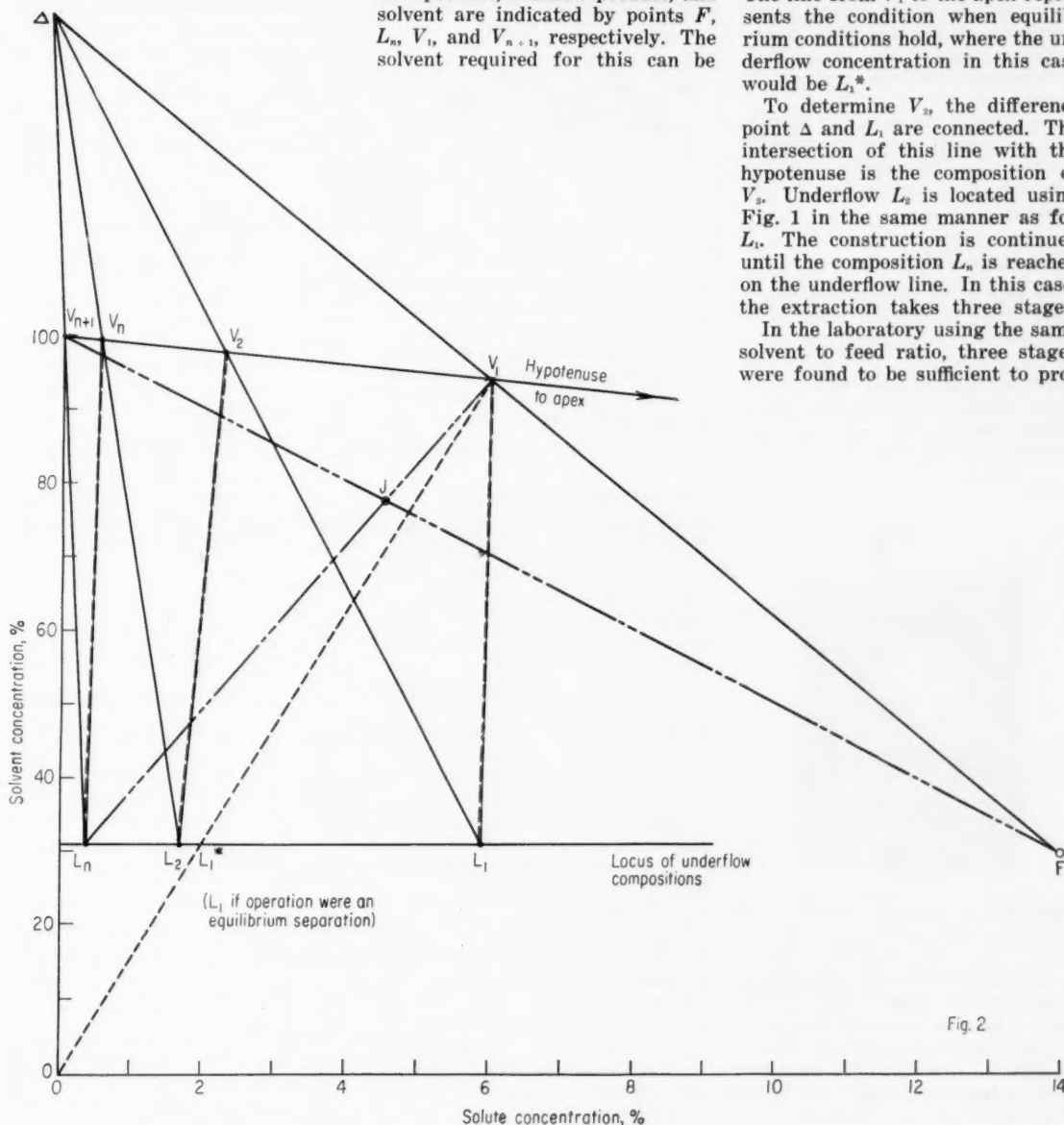


Fig. 2

duce the 99.5% product with intermediate concentrations the same as shown in Fig. 2.

The method can be summarized as follows:

- Slurries are prepared containing various quantities of solute and extracted for a given period of time at a specified temperature using the expected solvent to feed ratio.

- The slurry is separated into underflow and overflow by whatever means is considered best—filtration, centrifugation or settling.

- The overflow and underflow from each slurry are analyzed, and the relation between overflow solute concentration and underflow solute concentration and the locus-of-underflow-concentrations are determined.

- Using these data, the extraction problem is solved graphically to determine the number of stages required in a countercurrent extraction.

Find Stage Efficiency

At this point we can now determine the individual stage efficiencies as contrasted to the overall stage efficiency. This stage efficiency is analogous to the Murphree plate efficiency¹¹ used in distillation column design. In this case the equation for efficiency would be:

$$e = \frac{x_n - x_{n+1}}{x_n - x'_{n+1}}$$

where x'_{n+1} is the concentration of x_{n+1} if equilibrium conditions held. In the problem above, the stage efficiency is not the same in each step. The concept of stage efficiency can be used to determine optimum operating conditions of time and temperature.

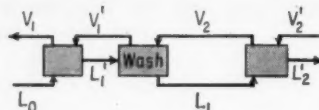
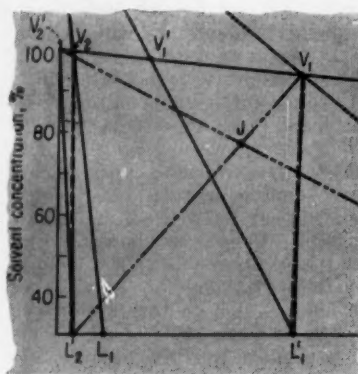
Calculations for Washing

The solution of problems which include not only non-equilibrium separations but also washing of the cake prior to removal from the filter or from the centrifuge basket can now be examined. This operation is shown schematically above.

The feed is extracted with wash filtrate, the slurry filtered, the filtrate is removed as concentrated filtrate, the cake is washed with filtrate from the second stage, the cake from the washing would be repulped with wash filtrate from the second stage and so on. This system, of course, could have a larger number of stages than we show in the illustration here.

The streams V_1 and L_0 , V'_1 and L'_1 , V_2 and L_1 , V'_2 and L'_2 are related by over-all material balances to the difference stream. The filtrate-filter cake $V'_1-L'_1$ is related by the experimental data. Problems with washing require one additional piece of information—the effect of washing the cake.

Variation if wash step is included



The displacement efficiency—defined as (solute removed in wash filtrate/solute initially in cake $\times 100$)—is determined as a function of the amount of wash expressed as a number of wash displacements (lb. solvent/lb. solvent in the pre-washed cake). For the first problem the ratio of solvent to feed was found to be 2.15. This is equivalent to 7.1 (2.15/0.30) wash displacements; and for our system the displacement efficiency is found experimentally to be 80%. That is, for a 7.1 displacement wash, 80% of the solute would be removed from the cake.

Above is shown a section of the graphical solution to this problem. The initial steps are the same as previously discussed. In this case, knowing V_1 , L'_1 is found using the experimental data relationship and then the wash filtrate concentration V'_1 is found by connecting L'_1 with the Δ point. The composition of L_1 , the washed cake, is found knowing L'_1 and the wash efficiency. V_2 is then determined by the Δ point material balance. The second cake L'_2 is determined from the experimental relationship (Fig. 1) and is found to satisfy the problem requirements. Thus, using extraction plus washing, two slurry-separation steps plus one wash are sufficient to produce the required product.

There must be an integral number of stages, since by using actual non-equilibrium data, real steps are involved rather than ideal.

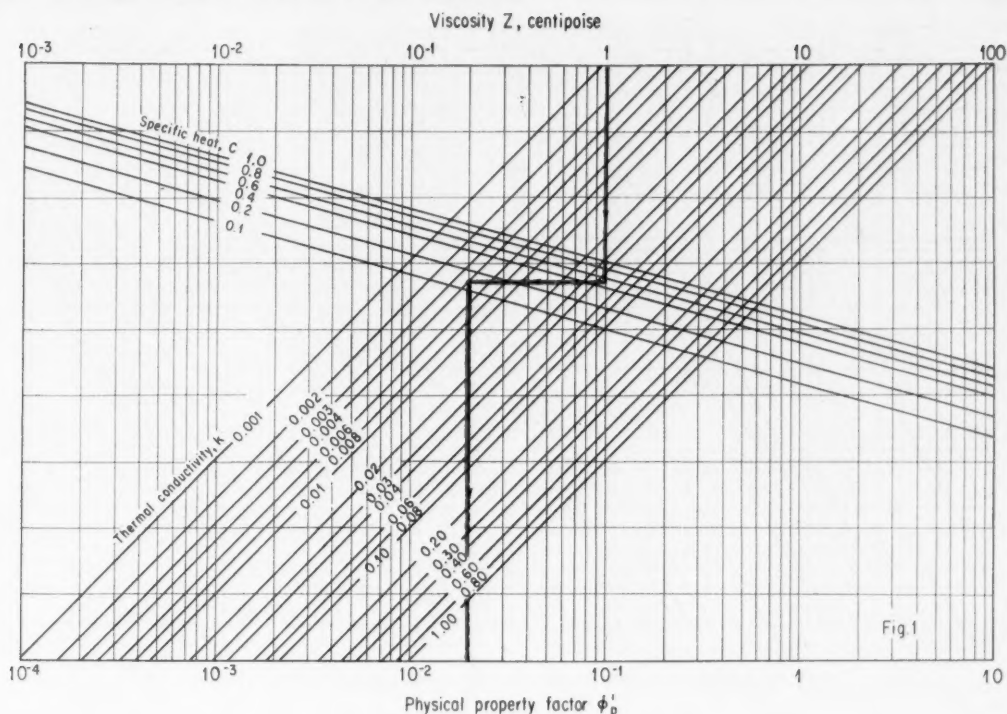
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Chart Gives Shellside Physical Property Factor



Graphs Help to Solve Shellside . . .

Heat Transfer and Pressure Drop

. . . Problems for Gases and Vapors

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In a previous installment¹ of the current series on graphical short-cuts for solving heat exchanger problems, we dealt with calculations for liquids on the shell side of baffled, tubular exchangers. Appropriate modification of some of the equations and graphs from that article provides this article's equally useful tools for dealing with shellside flow of gases and vapors.

Find Heat Transfer Coefficients

Donohue's equation² relating shellside heat transfer coefficient with physical properties and exchanger specifications is:

$$\phi_p h_s = 64 [(G_s')^{0.6} / (D_s')^{0.4}] \phi_p' \quad (1)$$

We use Eq. (1) to construct Figs. 1 and 2.

The following example illustrates the use of Fig. 1 to determine physical property factors, and Fig. 2

to find shellside heat transfer coefficients.

Problem 1—Find the shellside heat transfer coefficient for a gas flowing through a 19½-in. I.D. shell at a rate of 60,000 lb./hr. The exchanger has 292, ¾-in. × 16 BWG tubes arranged on a ½-in. triangular pitch into 16 rows. Spacing between each of the 38 baffles is 4.5 in.; baffle cut-out is 20%.

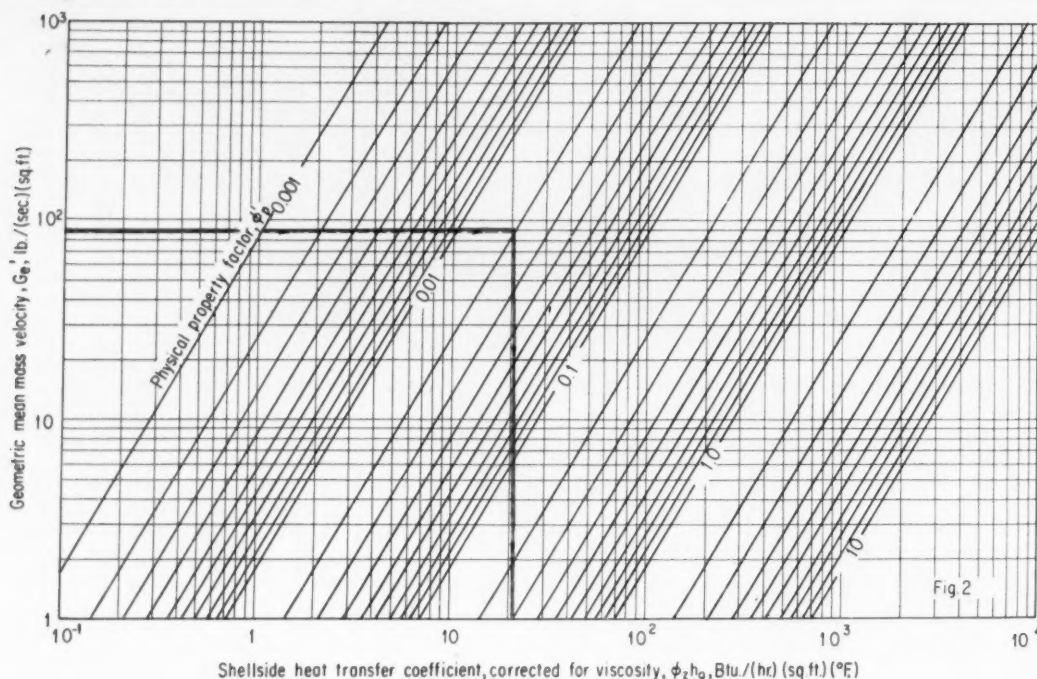
At the average operating temperature, the gas's properties were found to be: $Z = 1.0$ centipoise, $k = 0.004$ Btu./hr. (sq. ft.) (°F./ft.) and $C = 0.5$ Btu./lb. (°F.).

Step 1—Find the geometric mean mass velocity, G_s' . According to the procedure described in a previous article¹ of this series, first calculate G_s' and G_s' , and then find G_s' graphically from Fig. 1 of that article.

By Donohue's method³, $G_s' = 107$ lb./sec. (sq. ft.) and $G_s' = 69.2$ lb./sec. (sq. ft.). Therefore G_s' is found to be 86 lb./sec. (sq. ft.).

* To meet your author, see *Chem. Eng.*, June 30, 1958, p. 140.

Use Graph to Find Heat Transfer Coefficient



Tube-Size Correction Factors for Fig. 2.

5/8 in.	1.076	1 in.	0.891
3/4 in.	1.000	1 1/4 in.	0.815

Step 2—Obtain the physical property factor ϕ_s from Fig. 1 of this article. Drop a line through $Z = 1.0$ to meet $k = 0.004$. Read the abscissa of this intersection on the bottom scale as $\phi_s = 0.0205$.

Step 3—Find the shellside heat transfer coefficient, corrected for viscosity, from Fig. 2. To do this, first

Nomenclature

C	Specific heat, Btu./(lb.) (°F.).
D_o	Outside diameter of tube, in.
F	Correction factor, $[Z/(P' - D_o')]^{-0.3}$
G_s'	Mass velocity through baffle opening, lb./(sec.) (sq. ft.).
G_c'	Crossflow mass velocity, lb./(sec.) (sq. ft.).
G_g'	Geometric mean mass velocity, lb./(sec.) (sq. ft.).
h_o	Heat transfer coefficient, Btu./(hr.) (sq. ft.) (°F.).
k	Thermal conductivity, Btu./(hr.) (sq. ft.) (°F./ft.).
N_b	Number of baffles.
N_r	Number of tube rows normal to flow.
P'	Tube pitch, in.
$(S.G.)_m$	Arithmetic mean specific gravity, referred to water.
Z	Viscosity at average temperature, centipoise.
Z_w	Viscosity at tube wall temperature, centipoise.
$\Delta P_o'$	Pressure drop through baffle opening, psi.
$\Delta P_s'$	Pressure drop across tube bundle, psi.
$\Delta P_b'$	Pressure drop through shell, psi.
ϕ_s	Physical property factor, $C^{0.0005} k^{0.0005} / Z^{0.207}$
ϕ_v	Viscosity correction factor, $(Z/Z_w)^{-0.14}$

draw a line through $G_g' = 86$ to meet the line for $\phi_s = 0.0205$. From this point, drop a line to the abscissa and read $\phi_s h_o$ as 21. Multiply this value by the tube-size correction factor (1.000 in this case).

Calculate Pressure Drop

When the arithmetic mean specific gravity³ $(S.G.)_m$ replaces the $S.G.$ term of the original design equations² for shellside pressure drop, the following relationship holds for gases and vapors in turbulent flow:

$$\frac{\Delta P_o' \times (S.G.)_m}{N_r} = \frac{1.98}{10^6} (G_s')^{1.5} \left[\frac{Z}{(P' - D_o')} \right]^{0.2} \quad (2)$$

Likewise, for streamline flow,

$$\frac{\Delta P_o' \times (S.G.)_m}{N_r} = \frac{8.37}{10^7} \left[\frac{G_s' Z}{(P' - D_o')} \right] \quad (3)$$

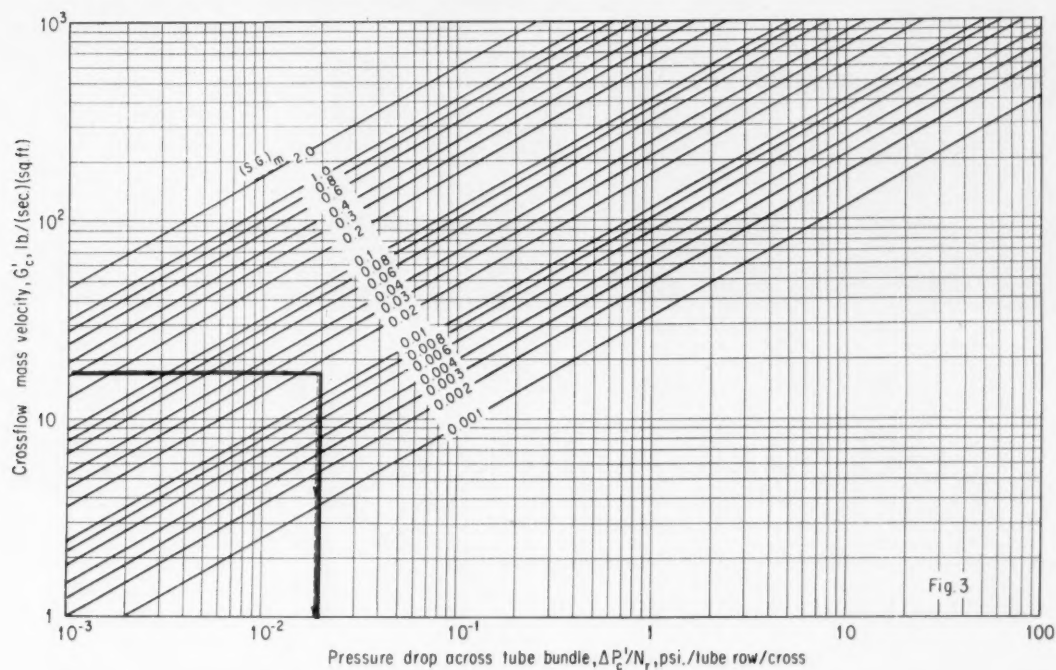
For flow through baffle openings,

$$\frac{\Delta P_b'}{N_b} = \frac{3.54 (G_b')^2}{10^6 (S.G.)_m} \quad (4)$$

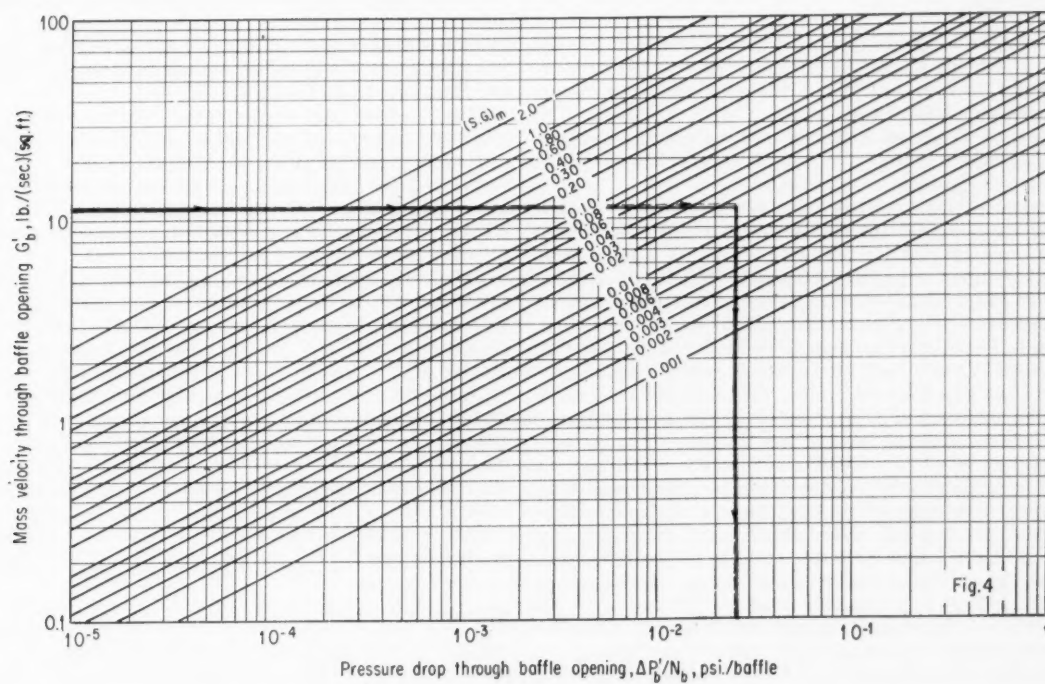
Figs. 3, 4 and 5 are based on Eqs. (2), (4) and (3), respectively. Two problems will serve to illustrate proper application of these graphical aids.

Problem 2—For an exchanger having the same specifications as that in Problem 1, find the isothermal shellside pressure drop at 100 F. for a vapor (molec-

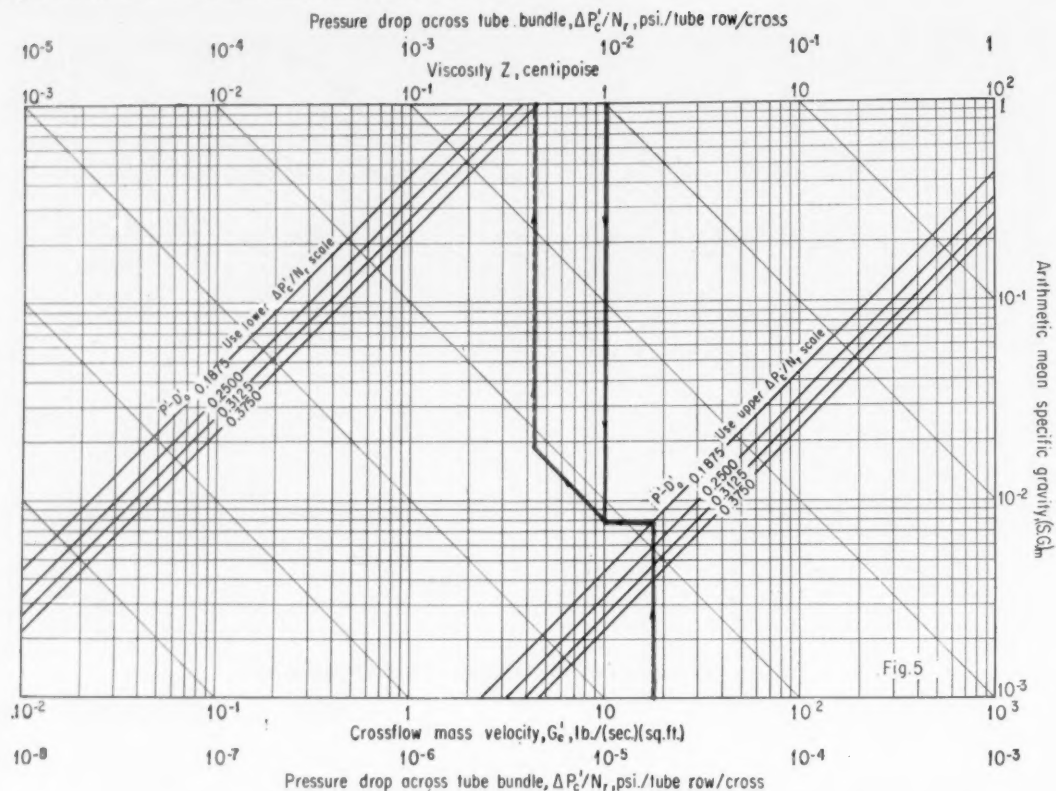
Find Shellside Pressure Drop for Turbulent Flow



Estimate Pressure Drop Through Baffle Openings



Graph Gives Shellside Pressure Drop for Streamline Flow



ular weight = 58) in turbulent flow at a rate of 10,000 lb./hr. At the operating pressure of 129 psi., vapor viscosity is 0.01 centipoise. Assume that the vapor behaves as an ideal gas.

Step 1—Find the arithmetic mean specific gravity of the vapor. From a chart in a previous article², $(S.G.)_m = 0.0185$.

Step 2—Next, find the value for $\Delta P'_c/N_r$. By Donohue's method¹, G'_c for this problem is 17.8 lb./ (sec.) (sq. ft.). On Fig. 3 (this article), draw a horizontal line through $G'_c = 17.8$ to meet $(S.G.)_m = 0.0185$. The abscissa of this intersection on the top scale gives the uncorrected value for $\Delta P'_c/N_r$ of 0.019.

Step 3—To correct the $\Delta P'_c/N_r$ found in Step 2, multiply it by correction factor F , which can be calculated as $[Z/(P' - D'_c)]^{-0.2} = 0.01/(11 - 3)^{-0.2} = 0.55$. Hence, corrected $\Delta P'_c/N_r = 0.019 \times 0.55 = 0.0105$ psi./row/cross. Multiplying by the number of rows and crosses gives $\Delta P'_c = 0.0105 \times 16 \times 39 = 6.55$ psi.

Step 4—Find $\Delta P'_c/N_r$ from Fig. 4. First calculate¹ G'_c as 11.6 lb./ (sec.) (sq. ft.). On Fig. 4, draw a horizontal line through $G'_c = 11.6$ to meet $(S.G.)_m = 0.0185$. Drop a line from this point to the bottom scale, and read $\Delta P'_c/N_r$ as 0.026 psi./baffle. Since there are 38 baffles, $\Delta P'_c = 0.026 \times 38 = 0.99$ psi.

Step 5—Assuming a safety factor of 1.2, shellside pressure drop $\Delta P'_c = (6.55 + 0.99)1.2 = 9.05$ psi.

Problem 3 (Streamline Flow)—Repeat Problem 2

assuming that vapor viscosity is 1.0 centipoise. Since this change puts vapor flow into the streamline range, use Fig. 5 instead of Fig. 4.

Step 1—Find arithmetic mean specific gravity of the vapor. Here, as in Problem 2, $(S.G.)_m = 0.0185$.

Step 2—Find $\Delta P'_c/N_r$. As before, $G'_c = 17.8$ lb./ (sec.) (sq. ft.). On Fig. 5, erect a vertical line through $G'_c = 17.8$ to meet the parameter $P' - D'_c$ of $\frac{11}{16} - \frac{3}{16} = 0.1875$. Through this intersection, draw a horizontal line to meet a line dropped vertically from $Z = 1$.

From this point, extend a line parallel to the 45-deg. guide lines to meet the horizontal line for $(S.G.)_m = 0.0185$. The abscissa of this last intersection, shown on the upper $\Delta P'_c/N_r$ scale, is 0.0043 psi./row/cross. Hence, $\Delta P'_c = 0.0043 \times 16 \times 39 = 2.63$ psi.

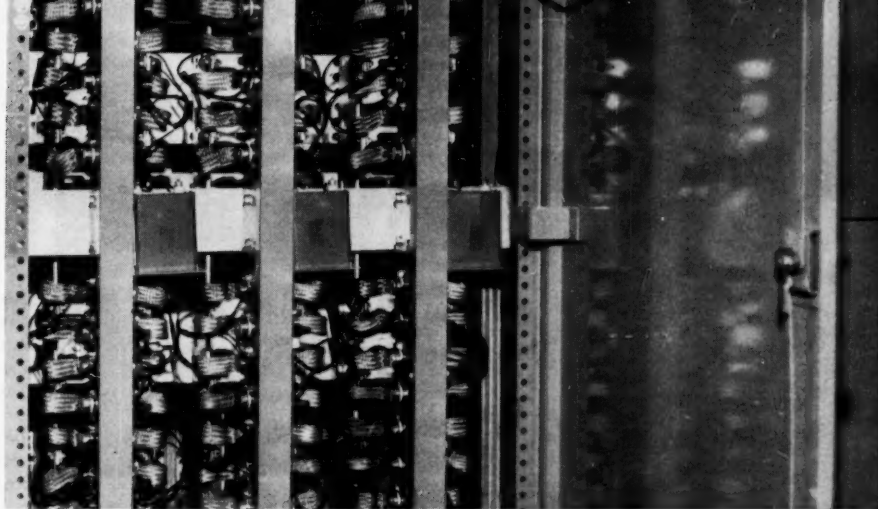
Note that since we operated with the right-hand set of parameter lines, we had to read the answer on the top $\Delta P'_c/N_r$ scale. Had the problem involved a G'_c necessitating use of the left-hand group of parameters, we would have read the answer on the bottom $\Delta P'_c/N_r$ scale.

Step 3—Inasmuch as the value for $\Delta P'_c$ is the same as in Problem 2, $\Delta P'_c = (2.63 + 0.99)1.2 = 4.34$ psi.

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WATER-COOLED silicon rectifiers (right) are popular for lower voltages; air-cooled equipment is used for voltages up to 850 v.



In electrochemical service . . .

Silicon Power Rectifiers Take Over

Low-cost, compact silicon rectifiers are latest word in d.c. power supply equipment for chemical service.

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R. P. STRATFORD and H. H. ZIELINSKI, General Electric Co., Schenectady, N. Y.

Of the three kinds of power rectifiers—mechanical, mercury arc and semiconductor—the newest, the semiconductor, offers important advantages in electrochemical service.

Semiconductor power rectifiers for converting a.c. to d.c. power have developed from laboratory devices to workhorses in heavy chemical service in slightly more than ten years. They represent low-cost, low-maintenance, compact, highly efficient and reliable d.c. power supply equipment.

Two semiconductor materials are used in these applications. Germanium was first in commercial equipment.

The material now dominating the semiconductor field is silicon. Although the properties of silicon rectifiers have been known for several years, it was not until the latter part of 1957 that they become accepted for power rectifiers. Only at that time did ultra-high-purity silicon become commercially available.

Silicon Displacing Older Types

Before the advent of semiconductors, the mercury-arc rectifier was the principal d.c. power supply used in the electrochemical indus-

try. However, it is not as good as the semiconductor (*see Table I*).

Mechanical rectifiers have had a relatively short commercial life in this country. In the last ten years, they have filled the need for more efficient conversion in the voltage range below 400-v. d.c. In view of their moving contacts and their sensitivity to a.c. voltage and frequency changes, only minimum cost and high efficiency could make them acceptable.

Today, however, the mechanical rectifier has to face the competition of the semiconductor. Even European manufacturers are no longer putting the emphasis on mechanical rectifiers. They are concentrating on semiconductors.

Semiconductor monocrystalline power rectifiers have been in successful operation in electrochemical service since early 1954. Since that time, more than 150,000 kw. (mainly germanium) have been installed and are supplying loads at very low voltages up to voltages in the 600-v. class, in ratings from 100 to 35,000 kw.

Silicon rectifiers are now being used almost exclusively for new power conversion installations in the electrochemical field. This is

because of their inherently higher voltage ratings, their suitability to operate at higher temperatures and higher current densities, and their relatively low losses, compared with germanium.

Key: High Purity

How has this come about? Ultra-pure silicon material has enabled physicists to make rectifying junctions which almost exactly conform to the mathematical equations of solid-state physics. Using this new material, in which impurities are measured in parts per billion, physicists have been able to make junctions with peak inverse voltage ratings approaching the theoretical limits between 1,500 and 2,000 v.

Rectifiers produced from this new material have very stable characteristics; this means that after any given number of hours or years of operation the characteristics of silicon rectifiers will be the same as they were the day they were put into service, provided they are used within their rating. Cleanliness and hermetic sealing at the time of manufacture are extremely important to preserve these characteristics.

Silicon diodes are being ap-



Theory Behind Semiconductors

It is absolutely essential to have ultra-pure silicon material to make good silicon rectifiers. But it is also necessary to add small, carefully controlled amounts of other materials to form a "P-N junction."

The basic physical theories of semiconductor rectifier operation are simple. Briefly, a slice of a Group IV element (silicon or germanium) in monocrystalline form is alloyed on one side with a Group III element (indium, aluminum, etc.) to make P type material. N type material is made by alloying with a Group V element. The border line or interface between the two types of material is called the junction.

The Group V element has introduced extra electrons into the crystal lattice of the

Group IV element—therefore they are relatively easily induced to move across the P-N junction to the P type material when a small electric potential is applied. For an opposite electric potential the electrons tend to move away from the P-N junction instead of toward and across it—therefore, no electrons move and there is no current at that particular instant.

Conventional current here is considered to be motion connected with the absence of an electron, or a "hole" in the crystal lattice. When an electron moves into a hole, it leaves a hole where it came from for another electron to move into. The apparent movement of holes will be opposite in direction to electron flow.

used for many years and is effective for all load ranges including relatively high overloads.

A second method uses dividing reactors that force uniform division of current among parallel elements. Several arrangements have been devised to include such devices in the equipment without preventing accessibility to the cells and their fuses. These reactors are quite effective at rated or design loads and below; but not on overloads or short circuits. The reactors will saturate and will not prevent the elements of minimum forward resistance from accepting an excessive load with consequent serious damage to them.

How to Protect Cells

To protect equipment from excessive overloads or short circuits, a standard overcurrent relay with extremely inverse time characteristic is used to trip the power circuit breaker feeding the rectifier. This relay characteristic matches that of the silicon cell and of the fuse quite closely. Such protection permits the equipment to stand normal load fluctuations without tripping unnecessarily.

What Equipment Is Available?

Air-cooled and water-cooled semiconductor power rectifier equipment is available. Air-cooled equipment is simpler in design where more than two cells are used in series for the required output voltage. Therefore, air cooling is preferred in equipment for higher output voltages.

A typical silicon air-cooled piece of equipment might be rated at 8,000 amp., 850 v. and have the following dimensions: 13-ft. 10-in. long, 54-in. wide and 100-in. high. Assembly includes an air-to-water heat exchanger and all auxiliary devices—including those used for fuse monitoring and those required for alarm and indication of overtemperature, loss of cooling air, etc.

Water-cooled silicon equipment as shown in the photo, p. 119, is used for lower output voltages up to 400 volts d.c. The assembly shown in the figure, with external transformer, can be rated 16,000 amp., 400 v. and has the following dimensions: 12-ft. long, 4-ft. wide and 7½-ft. high. This assembly also would include a water-to-water heat

plied today at voltages approximately 2½ times the maximum voltages for germanium. And since the forward voltage drop is approximately 50% higher than that of germanium, when both are applied at their maximum voltage level the efficiency of silicon is even higher than the already excellent efficiency of germanium. Since the silicon rectifier has a higher maximum allowable operating temperature than germanium, it is now possible to build more compact rectifiers.

Table II shows a comparison between the two types of rectifier cells.

Special Design Considerations

A single silicon cell* must be applied in such a way that the most severe duty encountered in practice does not produce a junction temperature in excess of 200C. Beyond

the rated continuous current, the cell must carry additional current (1) due to physical arrangement of the circuit, (2) to take care of overloads required by the application, (3) to take care of short circuit requirements, and (4) for possible contingencies. When semiconductor cells are applied with these factors in mind, the equipment will be capable of withstanding any duty placed on it in electrochemical service without exceeding the permissible load on any of the individual cells or the equipment as a whole.

Semiconductor rectifiers may have a large number of relatively small cells connected in parallel to produce the required current for electrochemical service. Two methods are used in order that the cells divide the load uniformly.

One method groups the semiconductor cells together with identical forward resistance—all the circuits connected in parallel divide the current equally. This method has been

*Not to be confused with the cells in an electrochemical plant. In this article the term "cell" is used for the silicon diode or element.

exchanger and all auxiliary equipment.

Only Part of the Story

The semiconductor rectifier assembly is, however, only part of the over-all equipment supplying the electrochemical load. Other equipment: switchgear, voltage regulators, rectifier transformers, control and metering equipment.

The a.c. switchgear is conventional and its rating depends upon requirements of the power system supplying the load.

Fig. 1 is a one-line diagram showing a section of a typical large rectifier system. A metal-clad power circuit breaker is used for each rectifier unit. This permits the operator to take any of the units off the line. Each unit is equipped with its own protective device so a fault in any unit may be corrected or any required maintenance performed without disturbing the other paralleled units. Voltage regulation in the system is provided by individual induction voltage regulators for each unit.

With the double-way rectifier connection illustrated in Fig. 2b, the rectifier transformer is of relatively simple construction. This circuit does not require use of an interphase transformer like the single-way circuit. Furthermore, the semiconductor rectifier transformer,

unlike that of the mercury-arc rectifier, is not subjected to the stresses of arc backs and resultant high surge voltages. Therefore, it requires less bracing and less surge voltage protection.

For d.c. metering, individual d.c. current transformers are used that measure the current in each rectifier section and also furnish a signal to the totalizing d.c. current transformer for indication of total cell line current. The over-all accuracy of such a system is 1% of full-load current including the error of 1% in the indicating instrument.

On the d.c. output side of the rectifier sections, between the rectifier and the d.c. bus, either disconnecting switches, d.c. air circuit breakers or disconnecting switch-fuse combinations are used depending upon the voltage level and application. Some means of short circuit protection is needed to prevent feedback from the cell line in case of a fault located in the equipment.

Note that rectifier systems of less than 750 kw. output are usually supplied from low-voltage power systems. In these cases the rectifier transformers are usually mounted in the rectifier cell assembly.

Other Applications Possible

Although electrochemical applications present the greatest potential

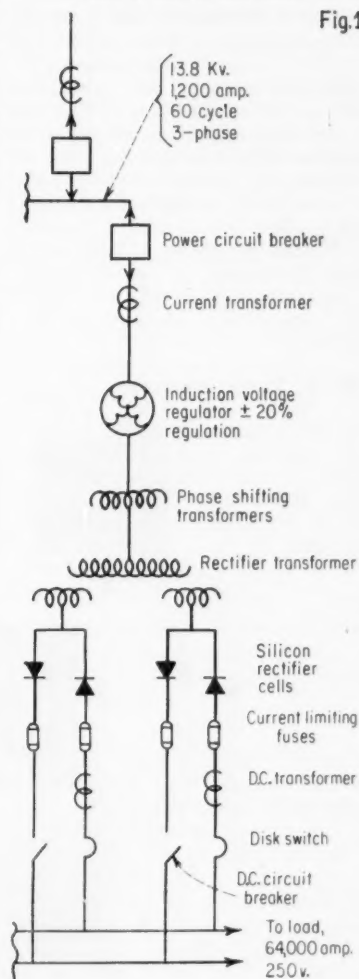
market for broad area semiconductor rectifiers, there are others of importance.

Silicon rectifier cells are being applied in areas where germanium was never used—one example is the d.c. unit substation, for blocks of miscellaneous d.c. loads. Typical ratings are 300 to 1,000 kw. with input voltages of 2,300, 4,160 or 13,800. The biggest advantage of silicon in this field is the high operating temperature which makes air cooling very practical. Silicon rectifier cells in this application are used at very low continuous current density so high current surges

How Silicon Rectifiers Fit Into Typical System

(one of four parallel units)

Fig. 1



How Some Power Rectifiers Compare—Table I

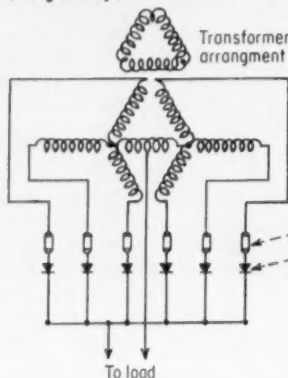
	Mechanical	Mercury Arc	Semiconductor
Efficiency	Good: 95-97%	Fair: 92-94%	Good: 94-97%
Power factor	Fair	Good	Good
Surge capability	Poor	Very good	Fair
Maintenance	High	Low	Very low
Cost	Medium	High	Low
Installation cost	Low	Low	Very low
Voltage control	Phase control	Phase control	External*

Silicon Is Outstanding in Semiconductors—Table II

	Operating Peak Inverse Voltage	D.C. Output Voltage†	Average Amp., %	Cell Losses, %	Cell Eff. at 100% Volts	Max. Junction Temp., C.
Germanium	92	75	100	100	97.9	75
Silicon	232	200	150	153	99.0	200

* Controlled semiconductor rectifier can be phase controlled but, as yet, its importance is limited in electrochemical applications.
† For 6-phase double-way circuit.

Fig. 2a: Double Wye (Single Way) Rectifier Circuit

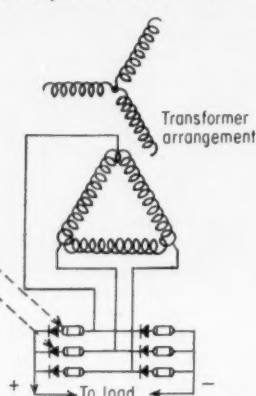


above the base load will not exceed the maximum rating of the rectifier cell.

These units are designed as a complete package including switchgear, induction voltage regulator to maintain a constant d-c output voltage, transformer, and air-cooled silicon rectifier section. Other so-called general-purpose silicon rectifiers have been designed for smaller applications than those requiring the d.c. unit substation mentioned on p. 121.

Normally a 460-v. nominal input

Fig. 2b: 3-Phase Bridge (Double Way) Rectifier Circuit



is used and a 250-v. d.c. output provided.

Standards Urgently Needed

Although silicon rectifiers have tremendous promise for the future, there are pitfalls which must be avoided if this rectifying element is to maintain its present good reputation.

The electrical manufacturers must resist the temptation to increase the rating of the rectifier cells too quickly in order to lower

their manufacturing costs. There have been no standards accepted in the industry although NEMA and AIEE both have committees working on the problem. Until standards are established a buyer must rely on the manufacturer's reputation, experience, integrity, and judgment to get properly designed rectifying equipment.

Just as we have seen continual improvement on rectifiers such as copper oxide, selenium and germanium we expect to see further refinements in the field of silicon rectifiers.

It is not possible to predict with much confidence when and what new developments will take place in the future. The silicon rectifier seems sure to dominate the electrochemical field below 600-v. d.c. for some time. Very soon economics will probably enable silicon rectifiers to serve the entire electrochemical field.

Some work is being done on the so-called III-V compounds, and on silicon carbide. Neither seems likely now except for special applications. Other possibilities include new sources of direct current, such as a nuclear battery, a solar device or a fuel cell. But at the present time the silicon rectifier is the undisputed "rectifier of the day."

Meet Your Authors



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How P & T Change Liquid Viscosity

Here are your "best bets" for engineering use. Of the hundred or so correlations in the literature, these will help you most.

WALLACE R. GAMBILL, Union Carbide Nuclear Co., Oak Ridge, Tenn.

In this series of three articles on the estimation of liquid viscosity we have already discussed how you can estimate values of viscosity for engineering calculations, even though you have no experimental data available. Now, we'll consider pressure and temperature effects.

Effect of Pressure

For saturated liquid and when $T_b < T < T_c$, we recommend that you use the curves of Smith & Brown for the chemicals which they have tested. These include hydrocarbons, alcohols and formates.²⁰

The effect of high pressure on the viscosity of subcooled liquids is imperfectly understood at present. Though μ_L has a greater pressure variation than almost any other pure-liquid property, the effect is rarely significant when the pressure is less than 10-40 atm. (The exact value depends on the nature of the liquid.)

Liquid viscosity increases with pressure for all liquids except water below 30 C. (and some aqueous solutions); the increase is almost linear with pressure up to about 1,000-4,000 atm., whereas at higher pressures the rate increases and the variation becomes logarithmic.

Pressure sensitivity of μ_L is greatest for those liquids of most complex molecular structure (and highest compressibility). At 11,700 atm., for example, μ_P/μ_1 for mercury is only 1.32; for methanol, 10; and for eugenol (4-allyl-2-methoxy phenol), it is 10⁷.

The chart on the next page further illustrates this point. It is based on the extensive data of Bridgman on the effect of pressure on liquid viscosities.²¹ At sufficiently high pressures, pure liquids will solidify, and mixed oils will do the same after partially crystallizing.

An Important Special Case

For the important special case of petroleum-derived lubricating oils, a very approximate empiricism is that:

$$\left[\frac{\partial(\ln \nu)}{\partial P} \right]_T \approx 5 \times 10^{-6} \left[\frac{\partial(\ln \nu)}{\partial(1/T)} \right]_P \quad (18)$$

where ν = kinematic viscosity, μ/ρ , centistokes; T = deg. K.; and P is atm. absolute.

It has also been shown that a curve of $\log \mu_L$ vs. $(1/P)$ is linear for many oils when the pressure is more than 1,000 atm.

Bondi²² has used as an average rule-of-thumb, based on many data, the statement that a pressure increase of 480 psi. will increase liquid oil viscosity to the same extent as a temperature decrease of 1 deg. C. Other studies dealing with the effect of pressure on oils include those of Cragoe²³ (animal, vegetable and mineral oils), Dow²⁴ (paraffinic and naphthenic lube oils), and Gunaji & Villemonte²⁵ (petroleum oils).

Moderate Ranges Only

For liquids in general, no accurate means exist for predicting viscosity-pressure variation over broad ranges. Old data-correlation forms, which are useful over moderate ranges of pressure variation, include:

$$\mu_P/\mu_1 = 1 + \alpha P \quad (19a)$$

$$\mu_P/\mu_1 = e^{\alpha P} \quad (19b)$$

for either of which the constant α may be calculated by using the following equation:

$$\alpha = Ae^{B/T}$$

where A and B are other constants.

Available μ_L vs. P data may be correlated over broader ranges with Irany's graphical procedure²⁶ or with one of two equations based on Eyring's absolute reaction rate theory.²⁷ The equations appear to be accurate to about 8,000 atm., but they require considerable data for numerical application.

You Are Here

Estimate Gas Viscosity

- Low-Pressure Gas Viscosity, Sept. 22, 1958, p. 169.
- How T and P Change Gas Viscosity, Oct. 20, 1958, p. 157.
- Get Viscosity for a Gas Mixture, Nov. 17, 1958, p. 157.

Estimate Liquid Viscosity

- With No Experimental Data, Jan. 12, 1959, p. 127.

How Pressure and Temperature Change Liquid Viscosity

Coming Soon

- Methods for Liquid Mixtures.

We also suggest that you consult papers by Panchenkov,³⁸ Telang,³⁹ and Andrade.^{10, 40} Andrade's correlation is:

$$\left(\frac{\mu_P}{\mu_1}\right)_L = \left(\frac{v_1}{v_P}\right)^{1/6} \left(\frac{k_1}{k_P}\right)^{1/2} \exp \frac{C(v_1 - v_P)}{T v_1 v_P} \quad (20)$$

where v is specific volume and k is adiabatic compressibility:

$$k = -\frac{1}{V} \left(\frac{\partial V}{\partial P} \right)_S \quad (21)$$

with the subscript S denoting constant entropy.

Since very few values of k , the adiabatic compressibility, are available, Andrade suggests use of isothermal compressibility:

$$k' = -\frac{1}{V} \left(\frac{\partial V}{\partial P} \right)_T \quad (22)$$

in Eq. (20). Though not clearly stated in Andrade's article,¹⁰ the constant C in the exponential term of Eq. (20) is the same as the C in Andrade's equation representing viscosity variation with temperature at constant pressure:

$$\mu v^{1/3} = B \exp \frac{C}{vT} \quad (23)$$

where B and C are constants and v is specific volume.

Eq. (20) applies only to the linear part of the μ_L vs. P curve, but for four organic liquids tested by Andrade (diethyl ether, acetone, ethyl bromide and ethyl iodide), the agreement is good up to at least 2,000 atm. In fact, for monatomic mercury, agreement is perfect at 12,000 atm.

This Is the Best

Andrade's correlation, Eq. (20), thus represents the best generalized expression available for estimating the effect of pressure on liquid viscosity, but it probably should not be trusted for pressures above about 2,000 atm.

However, this upper limit is sufficiently high to include practically all industrial operations.

Effect of Temperature

Values for liquid viscosity cover a very broad range, from about 10^{-6} poises for helium to 10^9 poises for glass. Variations are due to the nature of the liquid and the temperature level.

As with pressure sensitivity, described above, the influence of temperature is greatest with the more complexly structured liquids. We

will be concerned in this section with thermal dependence of μ_L at constant pressure; for a saturated liquid, where pressure and temperature change simultaneously, one should refer to Ref. 26.

Over 100 Correlations

This writer is aware of about 100 correlations that give the temperature dependence of μ_L , either directly or indirectly, through such variables as free volume, density, vapor pressure or surface tension. In this article the bulk of our discussion will involve only the half dozen or so of these correlations that are of greatest engineering utility.

References 41 to 55 refer to 15 other correlations which are especially interesting, novel or promising; few of these have been tested adequately, however, and they are probably of more interest to the physical chemist than to the chemical engineer. A number of these and other similar correlations have been listed by Doolittle in Ref. 56.

When You Know Two Values

Undoubtedly, the best all-around method for engineering use, when you know two or more values of liquid viscosity vs. temperature, is "Andrade's equation":⁵⁷

$$\mu_L = A e^{B/T} \quad (24)$$

which was actually derived earlier by both Reynolds⁵⁸ and de Guzman.⁵⁹

This relation was also rederived later from a semitheoretical viewpoint by Eyring, et al.,^{57, 67} and by Prasad.⁶⁰ The early history of the equation was discussed in a series of letters.⁶⁰

If logarithms are taken:

$$\log \mu_L = A' + (B/T) \quad (25)$$

indicating a linear plot of $\log \mu_L$ vs. $1/T$, which is the "standard" data correlation method used so often.

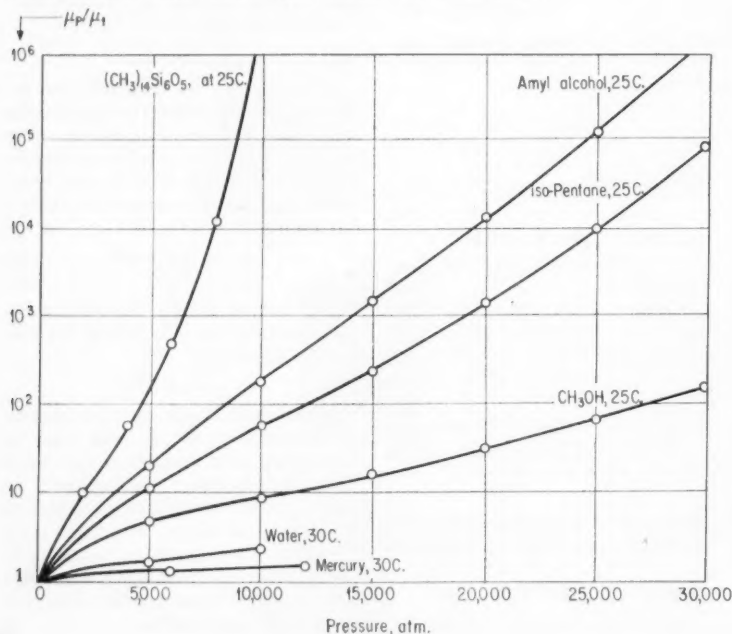
It has been amply demonstrated that the accuracy of Eq. (24) is as good as that of most experimental data. Correlation within 1-2% has been obtained for many inorganic and organic liquids, for fused salts and glasses and for many salt solutions (those not highly concentrated). The error is greatest for highly polar liquids.

A Later Modification

Andrade later⁶⁰ modified Eq. (24) to Eq. (23), mentioned previously:

$$\mu v^{1/3} = B e^{C/vT} \quad (23)$$

Bridgman's Data Show the Effect of Pressure



and claimed¹⁰ a slightly better fit for large ranges of viscosity.

Eq. (23) has been thoroughly (and successfully) tested with data for many organic liquids, for fused salts and mineral oils and for liquid metals, including Na, K and NaK. The fit was not as good for water and tertiary alcohols. Srinivasan & Prasad¹¹ found Eq. (23) no more accurate than Eq. (24) and concluded that its additional complication is unnecessary.

Thomas' Among the Best

A third μ_L vs. T equation which appears to be among the best is Thomas':¹¹

$$\log (\mu_L \nu^{0.5}) = c + k \left(\frac{T_c}{T} - 1 \right) \quad (26)$$

where c and k are constants.

For 123 liquids, Thomas' equation was as accurate as either of Andrade's equations.

Graphical reference-substance correlations have been proposed by Porter¹² and by Othmer & Conwell.¹³

Important Special Case

For the important special case of petroleum oils, a special graph paper, known as the "ASTM Viscosity-Temperature Chart for Liquid Petroleum Products" (ASTM D341-39), is available.

The chart is a plot of the double logarithm of the kinematic viscosity (in centistokes) vs. the logarithm of the absolute temperature and is based on one of Walther's double exponential equations:¹⁴

$$\log \log (\nu + 0.8) = -n \log (T/T_1) + \log (\nu_{T_1} + 0.8) \quad (27)$$

where ν is kinematic viscosity in centistokes; n is a constant; and T is absolute temperature.

Nomenclature

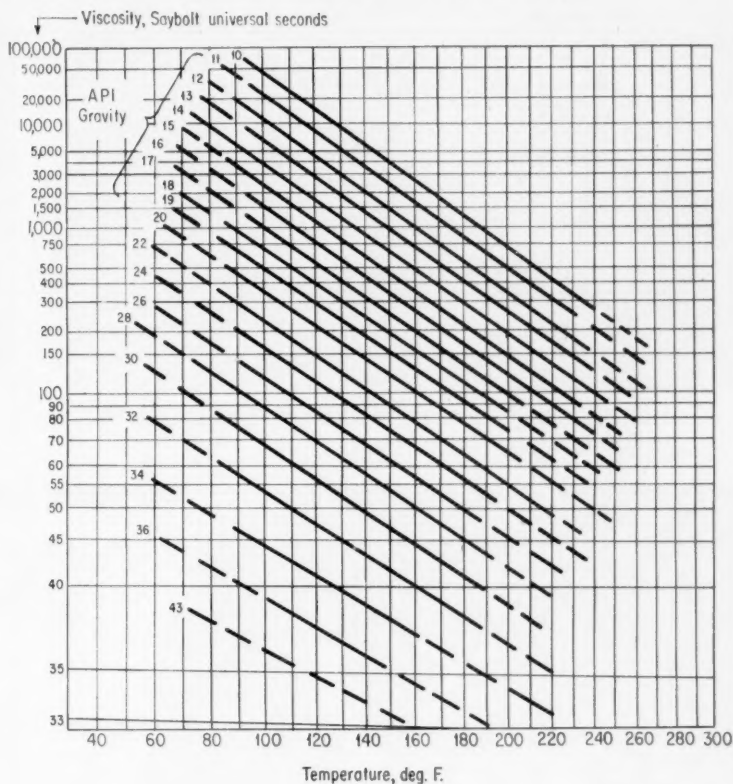
(Units are given in the text.)

k	Adiabatic compressibility.
P	Absolute pressure.
T	Absolute temperature.
v	Specific volume.
V	Volume.
μ	Viscosity.
ϕ	Fluidity.

Subscripts

1	At 1 atm. abs. pressure; or at the initial temperature.
b	At the normal boiling point.
c	At the critical point.
L	Of the liquid.
P	At some higher pressure.

Chart Gives Temperature Variation of Oil Viscosity



Eq. (27), in turn, grew out of earlier formulations of the correlation by Walther.

A Very Recent Entry

The recently developed "NRL chart",¹⁵ covering a viscosity range of 0.4 to 20,000,000 centistokes, is a modification of the ASTM plot wherein low and high ranges have been combined and where the upper temperature limit has been increased from 400 to 700 F.

For lube oils, common empirical refining indices involving viscosity include the viscosity index, V. I., and viscosity-gravity constant (V. G. C.).

The chart above, adapted from Ref. 66, gives the approximate temperature variation of crude-oil viscosity; for temperatures below 100 F. the accuracy is uncertain because of possible wax precipitation.

When You Know Only One Value

When only one value of viscosity is known for a substance, the easiest

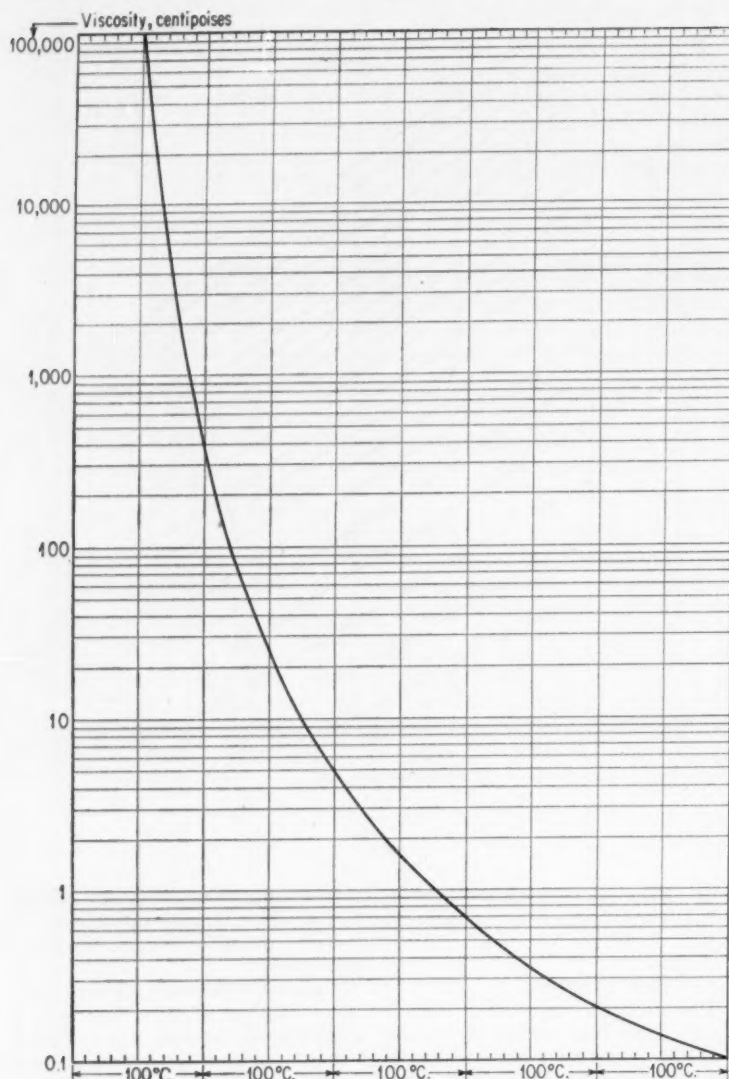
way to obtain approximate viscosities at other temperatures is to use the plot which is illustrated on the next page.^{6, 17}

This chart is based on data for a large number of very diverse liquids, mainly organic, but including water. Mercury is completely abnormal in relation to this curve, and some pure organics are anomalous. But, generally, deviations do not exceed 20% and average less, especially at high viscosities. However, the chart should not be used for suspensions or emulsions. (Estimates for mixtures, including suspensions and emulsions, will be discussed in the next article in this series.)

How to Use the Chart

To use the chart, merely locate the known value of μ_L on the viscosity scale and then follow the curve the necessary amount—as indicated on the abscissa—to reach the temperature at which μ_L is desired. Each major division on the

Easiest Way to Get From One Temperature to Another



abscissa scale represents a change of 100 deg. C.

Some Other Methods

Other methods include Johnson's reference-substance graphical procedure⁶⁶ and two one-constant equations.

The first equation¹¹ states that:

$$\log (\mu_s v^{0.5}) = 1.167 \quad (28)$$

from which was derived:

$$\log (\mu_L v^{0.5}) = 0.0670 + k \left(\frac{T_s}{T} - 1 \right) \quad (29)$$

where μ_L = millipoises; v = specific

volume in cc./gram.; k is a constant; and T is in deg. K.

The mean value of 1.167 in Eq. (28) held within 6% for 96 liquids. The " k " value of Eq. (29) was subsequently correlated with molecular constitution to give Eq. (1) and Table I (see *Chem. Eng.*, Jan. 12, 1959, p. 127).

The second equation⁶⁶ is:

$$\log \phi = 0.24 \log (P_v / P_s) + b \quad (30)$$

where ϕ is the fluidity and equals $1/\mu$; P_v is the vapor pressure; P_s = critical pressure; and b is a constant.

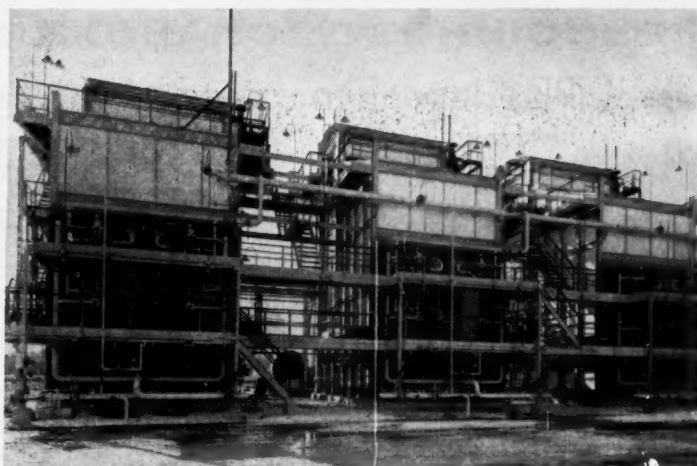
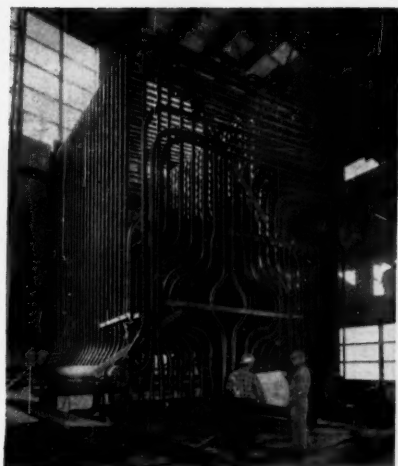
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AT LEFT: Installing a 60,000 lbs/hr unit in a brewery

ABOVE: A battery of 125,000 lbs/hr units in a chemical plant

CUSTOM *Steam*

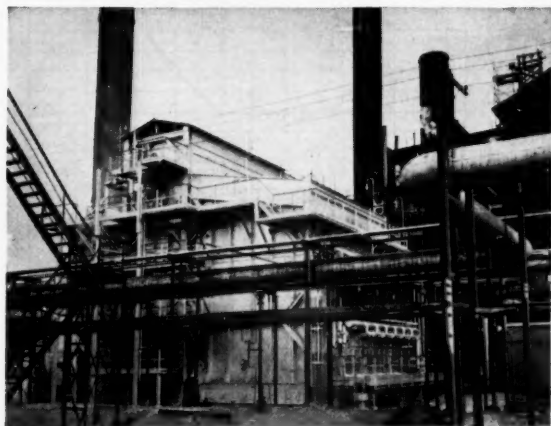
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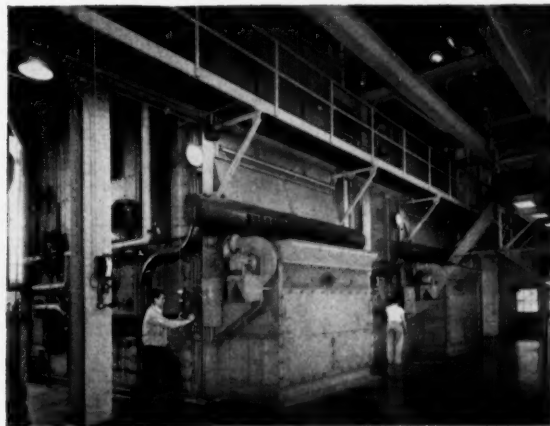
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(including weatherproof covering)

Foamglas

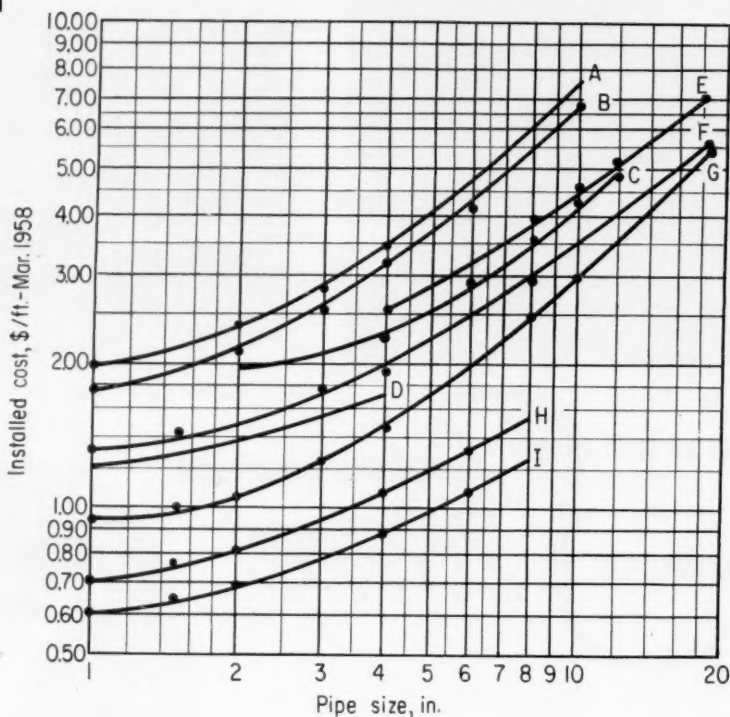
- 2" thick—A
- 1½" thick—B

Kaylo

- 2" thick—C
- 1½" thick—D

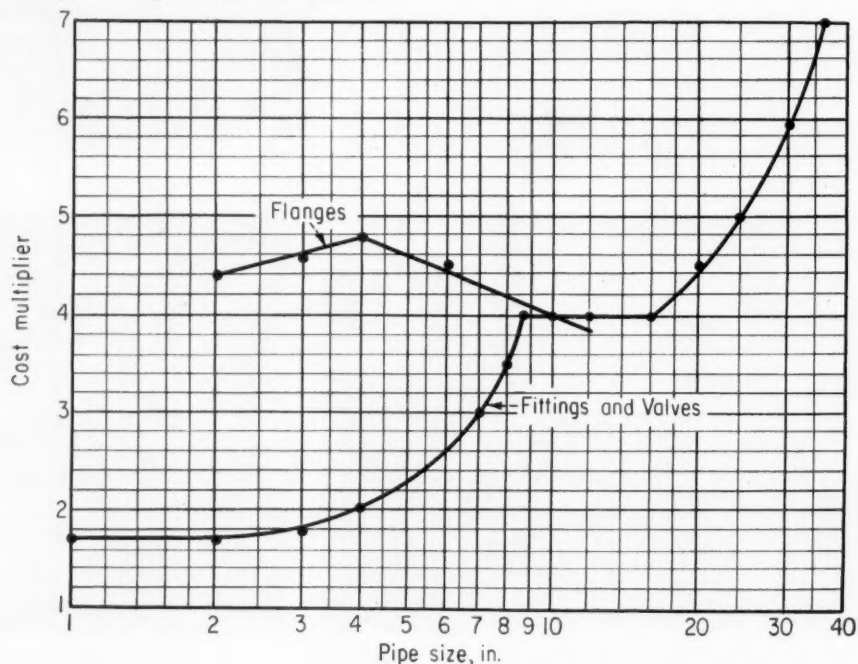
Fiberglas

- 2" thick—E
- 1½" thick—F
- 1" thick—G
- ¾" thick—H
- ½" thick—I



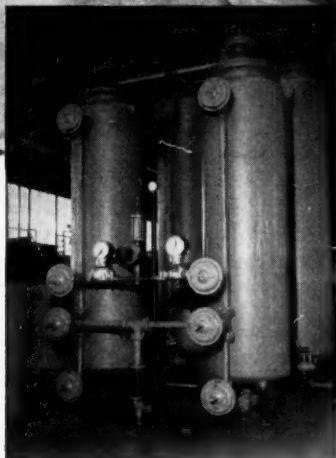
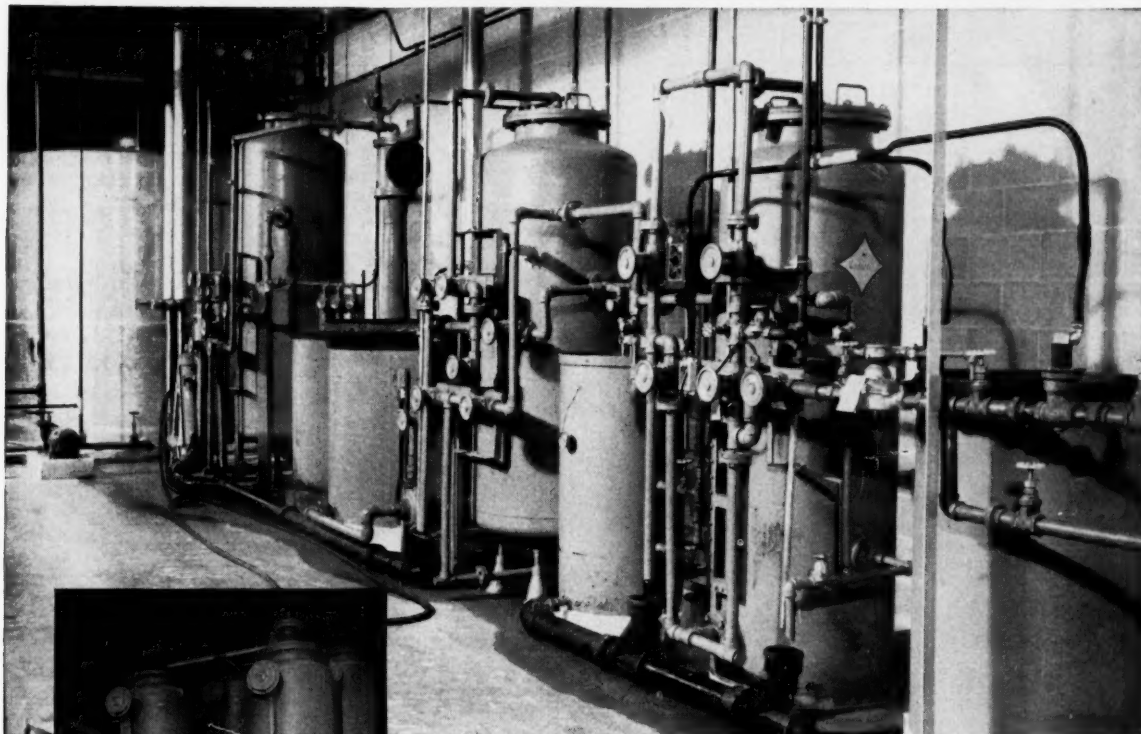
Fitting or flange insulation (with covering)

Cost = Cost multiplier x Pipe insulation cost, \$/ft.



INDUSTRIAL ION EXCHANGE TECHNIQUES

... low cost solution to specialized purification problems



EXAMPLE 1: Purification of Formaldehyde. Specialized anion exchange technique removes formic acid from formaldehyde. This Industrial semi-automatic, dual unit also "up-grades" water white formaldehyde for resin manufacture—yields final resins with resistance to off-color blush or bloom.

EXAMPLE 2: Chemical preparation. An Industrial mixed-bed ion exchange unit used for removal of sodium formate and formic acid from an organic polyhydric alcohol intermediate. Process facilitates subsequent purification by evaporation.

• Are you concerned with the removal of mineral impurities from solvent solutions—chemical intermediates—purification of glycerine—or other materials which usually require tedious, costly processing by alternate methods? If you are faced with the problem of purifying such materials, and if they contain even traces of moisture, then *Industrial*-engineered ion exchange techniques and equipment may provide a complete and inexpensive answer to your problem.

The two installations of *Industrial* ion exchange equipment illustrated here are typical of the many specialized applications of ion exchange developed and engineered by *Industrial* to meet specific chemical process industry requirements.

To evaluate the possibilities of these techniques to solve your purification problems, and to obtain an analytical study, consult *Industrial*, soon.



For general information covering *Industrial* Ion Exchange equipment, write for a copy of BULLETIN 200.

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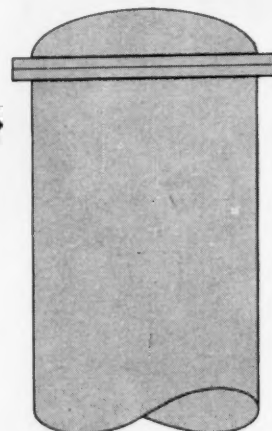
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PRESSURE FILTERS ♦ ION & HEAT EXCHANGERS ♦ WASTE-TREATING EQUIPMENT



← **More complex vessel head is actually less expensive to build than simpler head** →

In a typical case, head at left weighs 20% less and needs less welding. It also simplifies and reduces cost of maintenance.



Unconventional Vessel Heads Save Cost

★ Winner of December Contest by

J. Klengen

Cost Engineer, Chemical Industry Rotterdam, Ltd., Rotterdam, Holland.

UNCONVENTIONAL design can save about 20% in the cost of heads for pressure vessels if we use the type of construction shown at the left above, rather than the usual dished head portrayed at the right. At first glance it is hard to believe that what looks like the more complicated construction can be the cheaper. However, we shall see that it needs less weight of material and less welding than the more usual dished-head construction.

In addition to a worthwhile saving in first cost, the recommended construction means cheaper maintenance when it is necessary to enter the vessel through the head. There is much less work in unbolting and replacing the small dished head and a substantial saving in replacing insulation.

Let us see how the cost factors

work out for a specific process vessel:

The vessel is to be 6 ft.-6 in. diameter, to operate at 100 psig. The wall thickness will be $\frac{3}{8}$ in. Conventional construction will require a large dished head weighing 1,350 lb. and two large flanges with bolts, nuts and packing, weighing about 1,000 lb. There will be 41 lin. ft. of welded seam.

In the improved construction we shall use a conical dished head with a 2-ft. diam. opening to which is welded a 2-ft. diam. by 1 ft. cylindrical section. The small dished head can be reduced in thickness to $\frac{1}{4}$ in. The two 2-ft. flanges will be much lighter in construction. Weight of the conical and cylindrical sections and the small dished head will total 1,450 lb. The two small flanges, their bolts, nuts and packing, will come to about 475

lb. Welded seam length will be about 39.5 ft.

Thus, material weights for the conventional head will total 2,350 lb., compared with 1,925 lb. for the recommended head. There will also be a reduction of about 5% in the length of weld required, and a considerably greater reduction in the weight of weld metal that must be deposited.

Comparing costs:

Conventional Head

6 ft.-6 in. dished head, 1,350 lb.	\$350
Two 6 ft.-6 in. I.D. flanges, bolts, nuts, packing, 1,000 lb.	400
Welding and assembling	60
	<hr/> \$810

Recommended Head

Conical dished head, 2 x 1-ft. cylindrical section, 2-ft. I.D. dished head, 1,450 lb.	\$400
Two 2-ft. I.D. flanges, bolts, nuts, packing, 475 lb.	200
Welding and assembling	50
	<hr/> \$650

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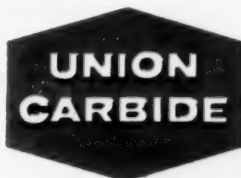
For varying needs. A DRIOX oxygen storage unit provides a continuous flow of liquid oxygen, or converts it automatically to gas. Constant pressure is maintained, even while the unit is being replenished. Or you can get LINDE oxygen in a single flask, a cylinder, or banks of cylinders.

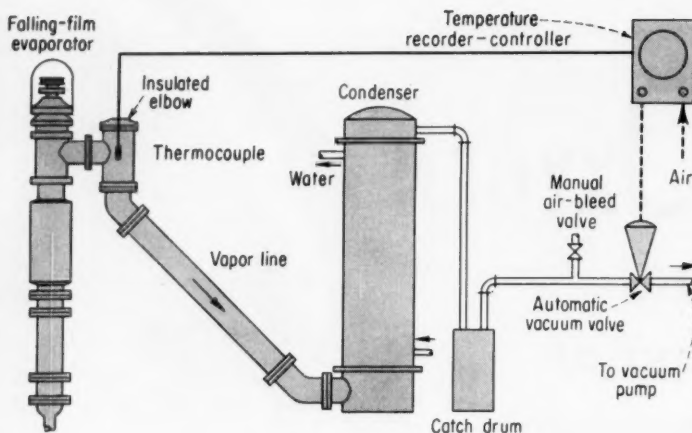
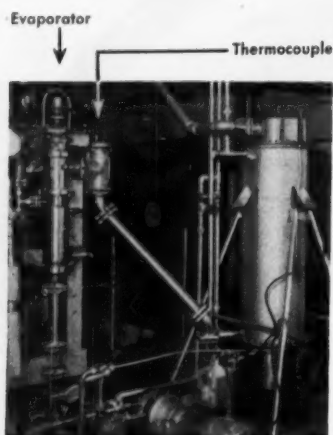
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Control Vacuum Evaporation by Temperature

Paul W. Kilpatrick

Chemical Engineer, Process Investigations, Engineering & Development Lab
USDA Western Utilization Research & Development Div., Albany, Calif.

ABSOLUTE pressure or vacuum controllers are not always available to suit a variety of processing conditions, especially in pilot-plant research on vacuum concentration of juices or other liquids. In such a case, thermocouple-type temperature controllers can be used satisfactorily to control the pressure during vacuum concentration.

One pilot plant installation using this method is diagrammed above, the evaporator and condenser being shown in the photograph. The evaporator is a continuous unit of the turbulent, falling-film type. The same control system has also been applied to a batch-type tilting vacuum pan.

In both sorts of concentrator, the pressure can be controlled satisfactorily by means of a temperature controller having a thermocouple sensing unit. The limitation on accuracy of vacuum control and range span is governed by the controller used.

One satisfactory control system consists essentially of: (1) a 30-ga. copper-constantan duplex-wire thermocouple installed in a 3-in. vapor line connecting the concentrator and condenser; (2) an electronic temperature controller of 0 to 200 F. range

span (accurate to 1% of span); an air-operated diaphragm valve installed in the vacuum source line and actuated by the output air from the temperature controller; and an air-bleed valve in the vacuum line between the condenser and the diaphragm valve which is used to stabilize the system load.

In operation the desired absolute pressure in the concentrator is obtained by setting the controller to the temperature corresponding to the vapor pressure at the desired operating condition. For reliable operation

it is important that no condensate be allowed to drip on the thermocouple bulb. There are several ways to prevent this, for example, by adequate pitch of the vapor line, or by localized insulation.

The system is started up manually, with the diaphragm control valve wide open or bypassed. Rough vacuum adjustment is then made with the air-bleed valve. Heat is applied to the concentrator jacket and when vapor starts coming over the switch-over to automatic control is made.

NEXT ISSUE: Watch for Winner of January Contest

★ How Readers Can Win

\$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award \$50 each four weeks to the author of the best short article received during that period and accepted for Plant or Process Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

\$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional \$100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates (\$10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

for durable, chemical-proof floors...

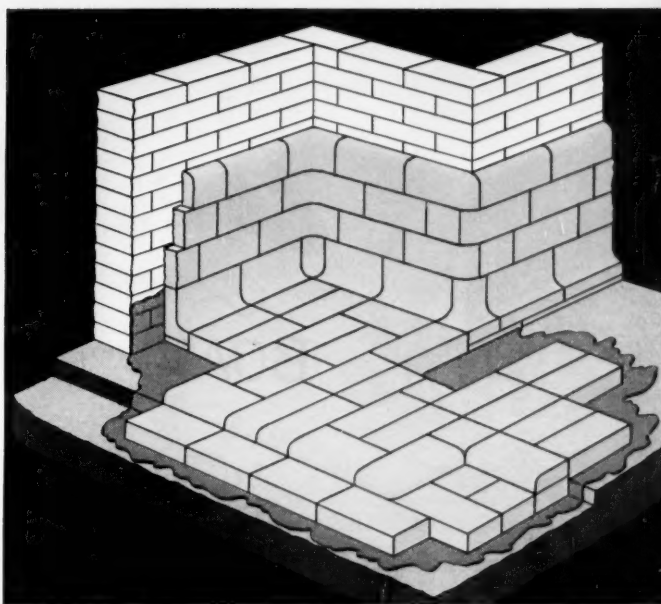
HARBISON-WALKER

DURC ACID-PROOF TILE

Duro tile are dense and non-absorbent throughout their entire thickness and are not dependent upon a skin glaze for resistance to penetration by corrosive liquids. The smooth, non-glassy surface of Duro is good for traction and the avoidance of slippage. Surfaces can be textured if desired.

Duro is vitreous to the most desirable degree for high strength to withstand impact and abrasion and for maximum impermeability and resistance to chemical action. This combination of properties is attributable to its stabilized chemical composition of aluminum silicate which is exceedingly low in the more soluble basic fluxes, such as iron oxide and alkalies, the vacuum method of forming and the high temperature at which it is fired. Its mineral constituents are converted to the most stable forms of greatest insolubility in acids and various corrosive materials.

The light buff color of Duro, with freedom from the glare caused by glazed surfaces, contributes to the



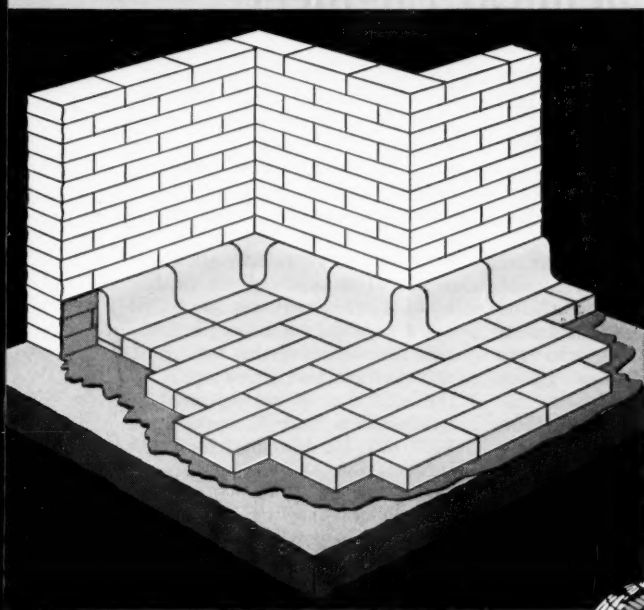
SHAPES AND SIZES

Depicted here are typical designs of DURO floor tile constructions using Harbison-Walker shapes and standard rectangular sizes as shown.

9" x 4½" x 1¼" ST
9" x 4½" x 1½" ST

9" x 4½" x 2" ST
9" x 4½" x 2½" ST

9" x 4½" x 3" ST
12" x 6" x 1½" ST



clean, sanitary appearance of the floors. The excellent workmanship of Duro tile and the variety of cove base shapes makes readily feasible a neat close fitting construction that is easy to keep clean.

Typical applications for Duro floors

Acid Rooms	Food Processing Plants
Bakeries	Galvanizing Departments
Bottling Plants	Meat Packing Plants
Breweries	Metal Fabricating Plants
Chemical Plants	Paper Mills
Dairies	Photoengraving Plants
Die Works	Rayon Plants
Electroplating Plants	Steel Pickling Plants
Electrolytic Metal Refineries	Textile Mills

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PRACTICE ...

YOU & YOUR JOB

EDITED BY R. F. FREMED



If You Look at It From the Board of Directors' Viewpoint . . .

You Can Be a Smarter Chemical Engineer

There are a lot of good engineers who can design processes that work successfully. What really separates the men from the boys is the ability to engineer for profit.

Charles E. Carroll, Walnut Creek, Calif.

Some years ago the company for which I then labored hired a consultant to survey their operations in the fine chemical field. This "expert" had concluded his studies and was pushing on the next day to a new assignment. Being in an expansive mood, he favored me with a few pearls of wisdom from his long experience.

"Charlie," he said, "I will tell you the secret of my success." As I listened with bated breath, he unfolded a tale that went something like this:

"When I am called in to survey an operation, early in the

game I request a plant tour. I make it a point to be introduced to as many as possible of the assistant production department heads and engineers who are familiar with operations. I then contact them individually and ask for their suggestions on how to improve operations. After a suitable period of time, I select the most promising of these suggestions, incorporate them in my report, and the job is done."

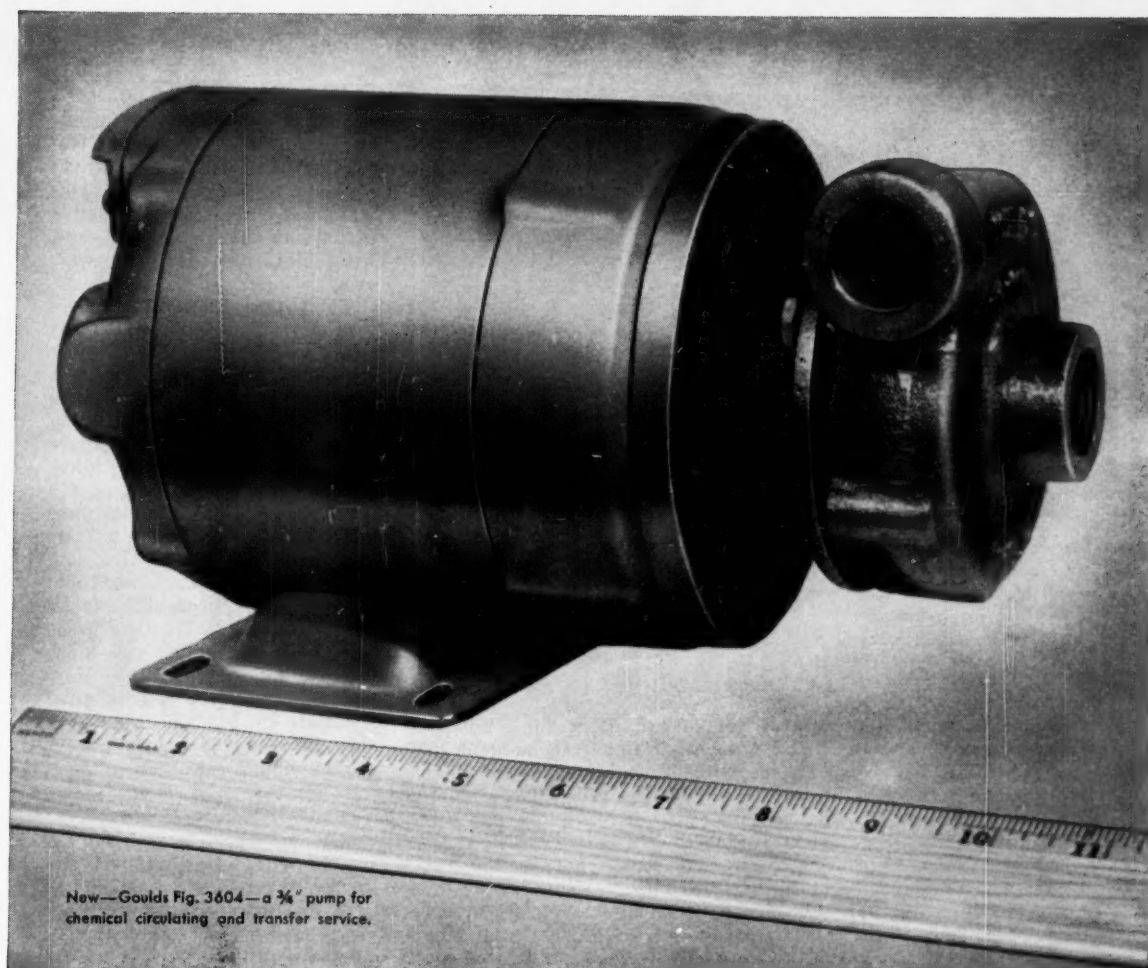
He went on to explain that practically every sub-department head who was worth his salt had spent lots of time considering ways to make the operations of

his department more efficient. Very likely he had presented suggestions along this line to his superiors from time to time. The combination of poor presentation on his part and resistance from above had resulted in the adoption of very few of them.

Therefore, allowed my friend, he as a consultant was performing a necessary and useful function in evaluating this wealth of information and bringing it to the attention of management.

The fact that it cost them \$100/day for him to "discover" information which was there all the time was only incidental. The important thing was the result. He was, he said, giving value for wages received. I could not help but agree with him.

What is the moral of this story to you? It goes, I believe, something like this:



Here's a small pump with big-pump stamina Ideally suited for handling corrosive materials

Small, compact—this new pump fits in where space is a problem. But you can rely on it for continuous service round the clock, round the calendar.

It's available from stock in 316 Stainless Steel—which provides the widest and most economical coverage of liquids commonly handled by a pump of this type.

The mechanical seal—with carbon, Teflon, stainless steel and ceramic parts—is noncorrosive.

The impeller clearance is externally adjustable to compensate for wear.

The pump is small enough ($10\frac{1}{2}$ x $5\frac{1}{2}$ x $5\frac{1}{2}$) and light

enough (23 lbs. with motor) for lab or pilot plant operations. It's designed for temperatures to 220° F. and working pressures to 75 p.s.i. Capacities to 16 GPM and heads to 28 ft.

For circulating duty, as a component in larger equipment, this new Goulds chemical pump offers advantages in size, weight, cost, and dependable performance.

Complete information on this high-quality pump—performance curves and specifications—is offered in Bulletin 624A4. You can get a copy from your Goulds representative, or by writing us.

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Assume that you are a staff process engineer in the J. R. Bigg Chemical Co. with the problem of designing an installation to double the production of framus dioxide. So what do you do? Acting like a good, well-trained engineer you get out the flowsheet, talk to a couple of the boys in the department who did the last job in the framus plant and you have most of the dope you need.

A few quick checks with the mechanical, instrument, and structural boys and you are ready for the draftsmen. Subsequently, you send a set of check prints to the super of the framus plant, get them back with his signature, and you are ready for the estimator.

And there you have it, a nice neat package. Sure it will cost a lot of money. But what is cheap nowadays? Hasn't the Marshall and Stevens' index gone up 3% a year since the last time we expanded the framus plant? Besides, everybody knows it will work; it's just a matter of adding a few tanks, pumps and a new reactor, just like those already installed.

So there you are, a good engineer doing a fine competent job for good old J. R. Bigg.

Or are you? Are you sure that there isn't another way to make that extra amount of framus di-

oxide and do it for a lot less money? Could it be done for \$10,000 less, \$25,000 less, or maybe even \$100,000?

Like a Million-Dollar Sale

Try looking at it this way: How much framus dioxide does the company have to sell to make the extra \$100,000 you might save? Well, if it is like most chemical products these days, J. R. Bigg would have to sell more than \$1,000,000 worth!

O.K., so what is the answer? How do you go about doing this poor-boy (high-profit) plant? Let's start with our friend, the consultant. What did he do? He spent a lot of time out in the plant talking to the people who operate the place, the department head, his assistant, the foreman, even the operators.

Let's go back to your standard procedure for design as outlined above. About the time you have familiarized yourself with the flowsheet of the framus plant, get off your well-padded chair and go out and look at the full-scale model. Get to know the people, the machinery, and the product first-hand. If it's a continuous process, there is no law against dropping in during the night shift a few times. You would be surprised what a problem a leaky valve can be at 2 A.M. on Sunday!

Then, make a real effort to find all the available information about the framus process. Look up some of the boys in research who worked on the original pilot plant. Spend a couple of days in the library and do a little literature search on your own.

Then comes the really important part. Take a long look at your projected design. Ask yourself a lot of questions like: Can't I substitute wood tanks for those rubber-lined holding vessels? Maybe if I really figure the pressure drop in that pipeline it can be 3" instead of 4"? How about Schedule 5 stainless pipe instead of Schedule 40? Do we really need a recording controller with automatic reset and derivative on the preheat tank?

Sure it's hard exacting work, but when you finish you know you have done something. Maybe you have pared your original estimate by \$25,000. Four jobs like that and you have made your million-dollar sale.

Sure It Applies to You

By now you have probably figured out that this article is not really directed to you since you are obviously not so uninformed as to over-design a plant in such a manner.

Let's see if we can go over a couple of more cases that might be closer to your experience.

Here is one I call the "Case of the Multiple Pumps." This happened to me some years ago. The process called for five vacuum stills with float-controlled pumps on each receiver. The pumps were 10 hp., 316 SS and of special low-NPSH design and thus represented a considerable investment. After some discussion with the production dept. representative, we decided to install duplicate pumps for each receiver. Apparently the stills could be shut down for a maximum of only 30 min. for pump repairs. This was obviously not long enough to repair a pump even under ideal conditions.

When I went over the flowsheet with the gentleman who was then my boss, he asked a few general questions and then said, "Very interesting, but which of your uncles is in the pump business?"

NO LEAKAGE...

*You're looking at the
newest thing in valves...*

STOCKHAM'S NEW WEDGEPLUG* "O-SEAL" VALVE

Two Teflon** "O" rings in the plug give constant vapor-tight shut-off... to give you double assurance of double savings on operating and maintenance costs.

NO LUBRICATION...

HOW TEFLON "O" RINGS WORK The two Teflon "O" rings are inserted in dovetail grooves machined on the face of the plug. These "O" rings seat on the raised body seats when the plug is in closed position.

CONSTANT VAPOR-TIGHT SHUT-OFF This sealing effect of the "O" rings gives absolute shut-off in all cases—shut-off that remains permanently "bubble tight." The Teflon "O" rings are chemically inert, practically frictionless, and will not cold flow.

TESTS PROVE POSITIVE SHUT-OFF

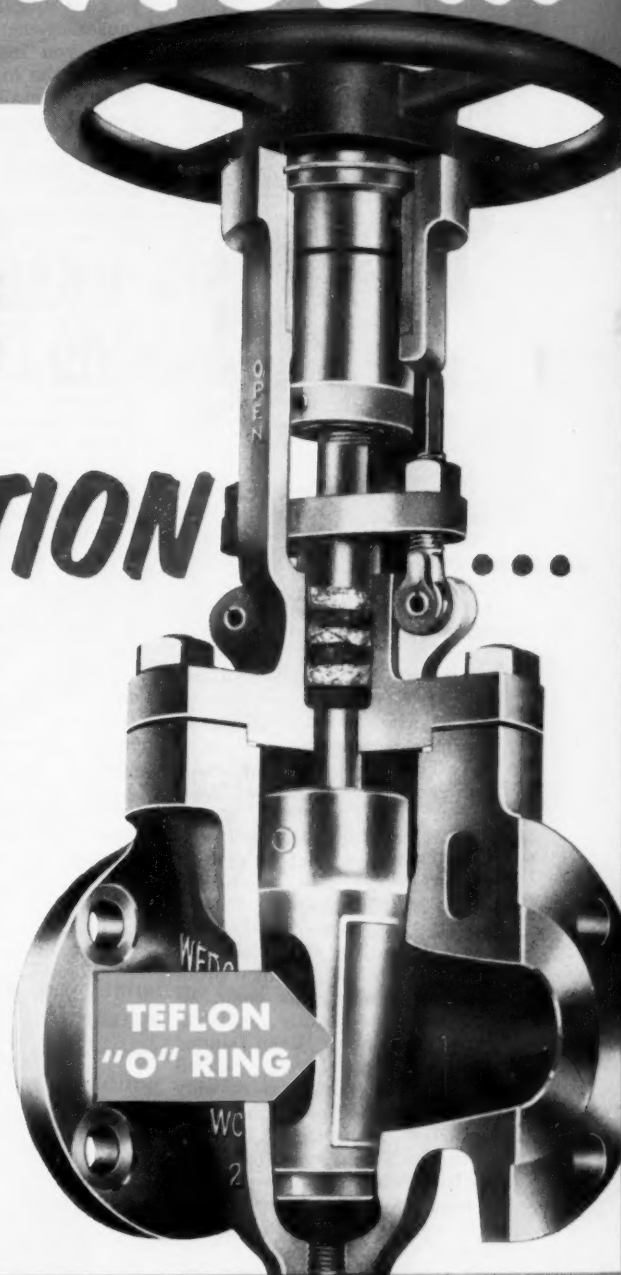
Hundreds of tests of this new valve in all types of services have failed to make it leak. Performance has been remarkable. In every case, the valve held "bubble tight" because of the pressure seal effect of the "O" rings.

OTHER OUTSTANDING ADVANTAGES

Non-Lubricated—no costly maintenance necessary • **Provides Double-Block and Bleed** in most services • **Quick, Easy Operation**—won't stick or bind • **Double Seating for Double Safety**—Ground metal-to-metal seat provides shut-off in case fire burns out "O" rings • **No Product Contamination** • **Protected Seats**

RECOMMENDED USAGES Stockham's new "O-Seal" is recommended for all general purposes—air, gas, water, steam, propane, hydrocarbons, etc., as well as for hard-to-hold services. Recommended for temperatures from minus 300 F to 400 F and not exceeding 720 psi.

Available in carbon and alloy steels, 2" - 12" sizes, 150 and 300 lb. pressures. Three port openings—40%, 70%, full round—wrench, handwheel, gear, and motor operated.



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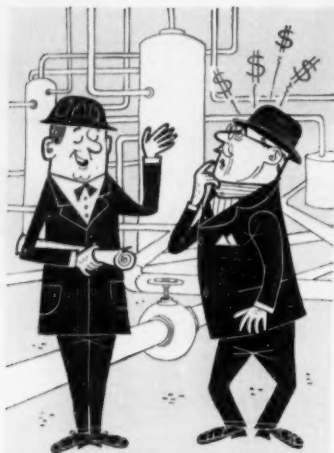
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I thereupon turned on my brightest look and stated, "But, sir, the process is essentially continuous, and besides the production man has a general rule that if a spare is required you might as well hook it up ready to go."

My boss then suggested I improve my general knowledge of the situation with a couple of specific observations.

- There are a lot of essentially continuous processes that do not justify duplicate equipment if carefully designed.

- There are a lot of general rules that are poor substitutes for specific thinking.

Well, you guessed it: I found a way to satisfy the production man that his maintenance problem on these pumps could be solved by one readily available, uninstalled spare. When I added up the savings I really scared myself. The pumps were only the start—you know the rest: 5 starters, 5 services, 5 bases, 5 piping hook-ups, spare parts for the installed spares and so on ad expensium.

When I reported this resolution of the problem to my boss, you may rest assured this produced some further pearls of wisdom:

"Charlie, you have to understand the essential difference in viewpoint of the production man and the design engineer. The production man is—and rightly so—primarily interested in a design that will operate with the least possible difficulty and in-

terruption from maintenance, process upsets and other allied causes. Generally speaking, the more you insure against these things, the higher the final cost of the installation. If you attempt to be a good guy, and give the customer everything he wants without really convincing both him and yourself that each item is absolutely necessary, you are not really doing your job!

Look at It This Way

"Try looking at it this way," he said. "When the Board of Directors authorized funds for this job they did not give you a license to spend money to the stated amount. They set aside funds to design and install a plant that will efficiently make the product with the least possible capital expenditure.

"This is your basic responsibility," he went on to say. "You are the representative of management in this area. No one else can do it for you. This is the engineer's basic stock in trade—the ability to work out installations that will result in a satisfactory product with the lowest practicable capital investment."

One final example, and this is admittedly the most difficult one of all. This is the problem of the balance between operating cost and capital expenditure. I real-

ize that many organizations have individuals or even departments devoted to solving problems of this nature. Suffice it to say, however, that whatever the system, if the engineer is not alert to discover potential problems in this area, improper decisions may be reached.

For example, suppose you have to design a water pipeline, say, 4,000-ft. long to handle 1,000 gpm. against a given static head. After you calculate it out and add your usual "J" factors for roughness, etc., you seem to have two logical choices:

- A 10-in. pipe with a 100-hp. pump.

- A 8-in. pipe with a 125-hp. pump.

After you estimate the installed cost of the two designs versus the projected operating costs, you find that you will get the extra investment for 10-in. pipe back in 4½ years! This is an expansion of a basic product the company will continue to make for a long time. Therefore, you install the 10-in. pipe and the 100-hp. pump.

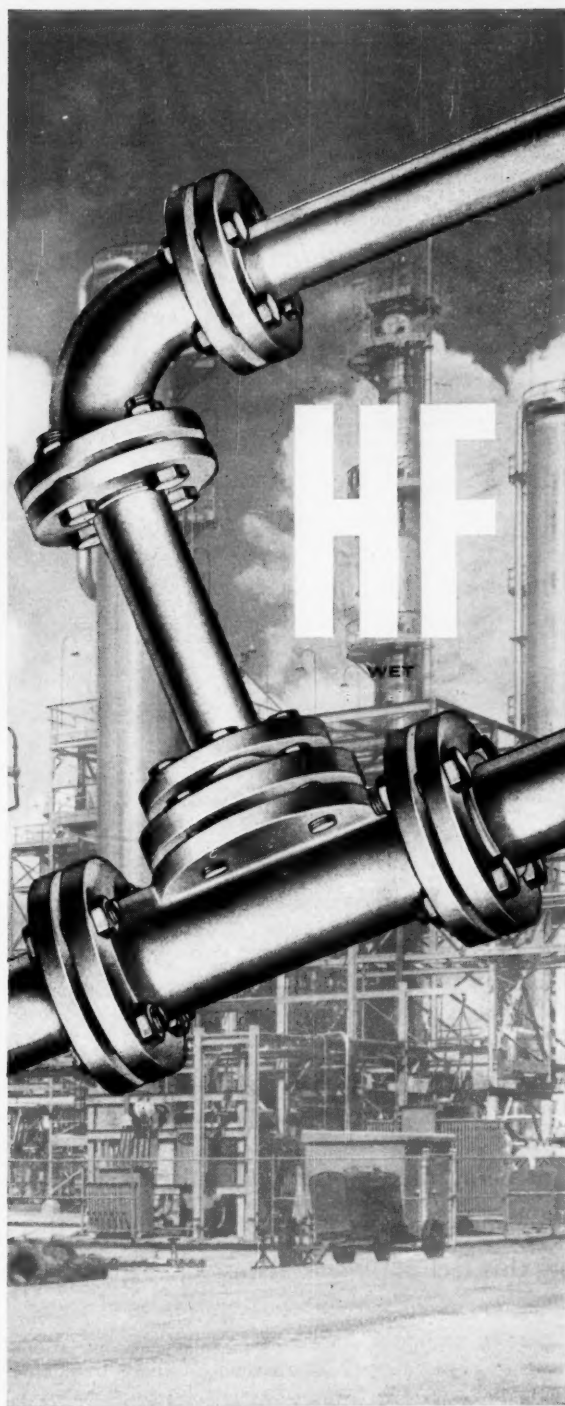
Well, let's look at this one from the Board of Directors' viewpoint. Say, for instance, that in the fiscal year which your project came up, the board decided that they could allot \$10,000,000 for capital expenditures. Say, that they considered projects with total estimated aggregate costs of \$30,000,000. Naturally they could approve only ⅓ of those presented. The projects they approved (assuming equal risk) were probably those with the shortest time to return the investment.

You have, therefore, probably made a wrong decision. To put it another way, the Board has higher-rate-of-return places it can invest the extra money you put into the pipeline.

Maybe I can best illustrate this opus by a final quotation from our friend, the boss. He said, "Charlie, you may think this company is organized to make chemicals, or maybe even to make jobs for you and me. This is not so. This is not primarily a chemical plant. It is a dollar factory. It is organized to make money for the stockholders; and whatever you do here, don't ever lose sight of this."



CHARLES E. CARROLL is a Plant Engineering Supervisor at Dow Chemical's Pittsburg, Calif., plant. He is a professional mechanical engineer with experience at Abbott Labs and Armour before he joined Dow. This article is an adaptation of a training talk that Carroll gives to groups of young engineers.



*Hydrofluoric acid in any concentration
at any temperature to 500°F...*

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TEFLON® liner
in thermal equilibrium
with housing

Lining is completely inert to all corrosives. It's made of Fluoroflex-T, a high density, non-porous compound* of virgin Teflon.

Liner and housing are in thermal equilibrium through an exclusive process developed by Resistoflex. It compensates for thermal expansion differential between the Teflon and the pipe housing, eliminating fatigue collapse, and cracking at the flange.

Reboilers constructed from Type S pipe are now in use handling boiling hydrofluoric acid with complete safety and no maintenance problems. Fluoroflex-T Type S piping systems can end maintenance problems for you, too. Bulletin TS-1A gives details. Write Dept. 202 RESISTOFLEX Corporation, Roseland, N. J. *Pat. No. 2,752,697

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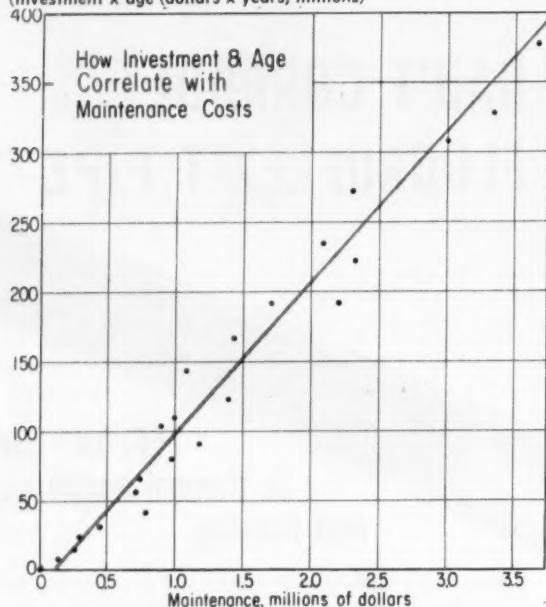
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New York 36, N. Y.

Maintenance Cost Estimation . . .**Is This a Better Tool for You?**

- This method is being used to estimate and control costs.
- What works for one company may not work for another.
- How well does this technique correlate your expenses?

Estimating and controlling plant maintenance costs is quite a problem. There've been a few attacks but most maintenance men feel it's like running into a stone wall—you can hit it pretty hard but it probably won't give.

You have four general methods available:

- Consulting company records on the same or similar operations.
- Using a percentage of investment costs.

- Estimating repair costs for each piece of equipment.

- Relating maintenance to power requirements.

From a major pulp and paper manufacturer comes a variation on the second method. They state:

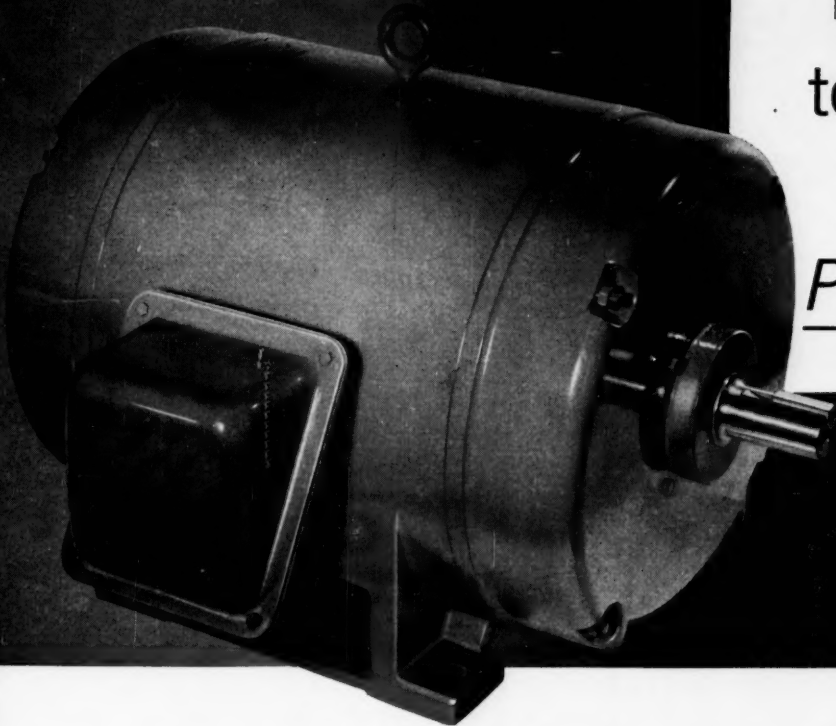
"The use of plant and equipment investment as a yardstick for evaluating maintenance seems to be a logical sequence following the adoption of capital investment as a yardstick to evaluate net income."

Today, maintenance people at one of this company's plants are using this correlation to forecast and evaluate annual maintenance, based on projected and known investments.

How Does It Work?

The quantity, investment times age, is correlated with annual maintenance costs. This correlation works remarkably well with the

Designed
to give you
Double
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WAGNER TYPE DP MOTORS

PROTECTED
against
corrosion...

PROTECTED
against splashing
liquids...

WM59-9

Wagner Type DP Motors provide *double protection* that means longer life—more versatility of application. Rugged cast iron frames and endplates are highly resistant to corrosion. Dripproof enclosures are so well designed that these motors can handle many applications that formerly required splashproof motors. These motors pack ample power into little space, are light in weight and are easy to maintain.

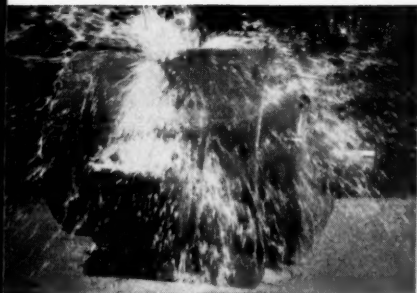
SLEEVE BEARING MODELS AVAILABLE. The entire line of ratings is available with ball bearing construction, or with steel-backed, babbitt-lined sleeve bearings of high load carrying capacity that provide quieter operation.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.

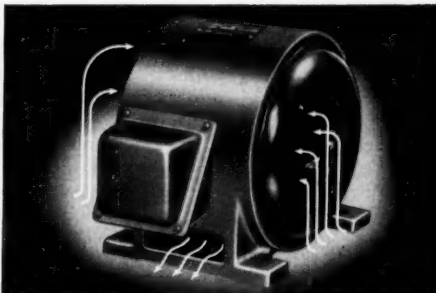
Branches and Distributors in All Principal Cities

Wagner Electric Corporation

6407 Plymouth Ave. • St. Louis 14, Missouri



DOUBLY PROTECTED—Air intakes and outlets are positioned to provide complete protection against dripping or splashing liquids. Rugged cast iron frames protect against rough handling and corrosion.



COOLING RUNNING—Specially designed baffles, which protect the stator windings, direct a cooling stream of air through the motor to effectively cool the motor—add to motor life.



CAN BE RE-LUBRICATED—Original factory lubrication will last for years in normal service—but grease plugs are provided to permit re-lubrication that adds years to motor life under severe conditions.

total annual maintenance bill for the same years.

Investment and maintenance values are in terms of current dollars. Investment values are the original undepreciated values remaining after retirements are deducted.

Investment-age units (\$-years) are recalculated each year to reflect age and investment changes.

Typical calculations are in the accompanying table.

Plotting investment-age against maintenance for the same year, as shown on p. 140, gives an apparent straight-line relationship. Line shown was statistically determined by the least-squares method and represents the best straight line for the data.

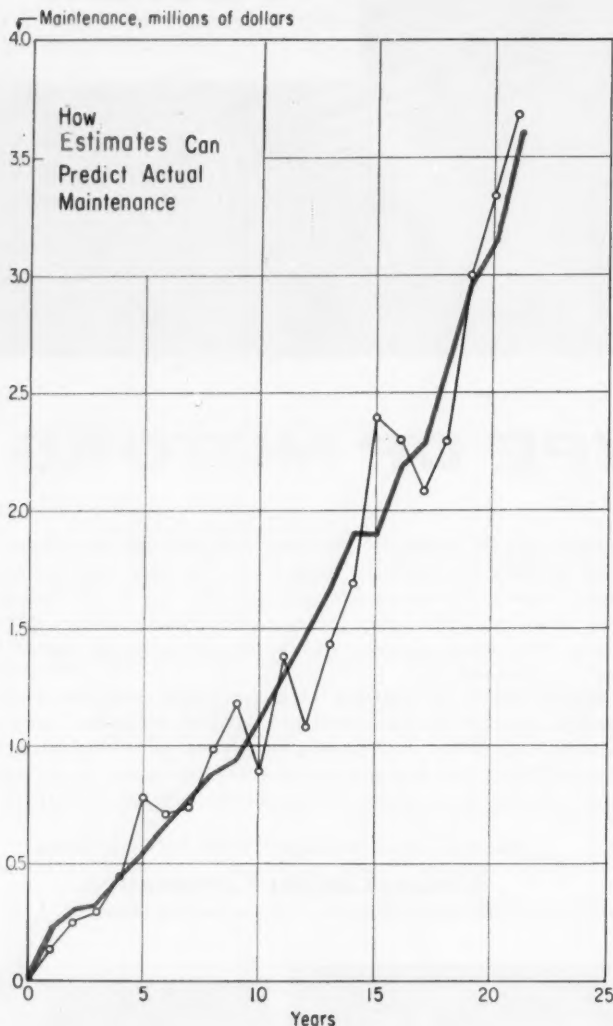
It's immaterial that this line doesn't pass through the zero-zero point (zero maintenance at zero years), as we know it should, since the line just represents a statistical interpretation of the data. Values derived from this line are the closest approximations—not true values.

Equation of this line is:

$$M = 0.009 I \times t + 149,000$$

where: M = annual maintenance in dollars and $I \times t$ = investment-age in dollar-years. What this means: Annual maintenance bills in this pulp and paper plant are approximately 1% of the investment-age figure.

Now, assuming a true relationship exists between investment-age and maintenance, we plotted maintenance costs gotten from known investment-age values—and using the equation. On the same chart (left) is shown the actual maintenance bills—a fairly close correlation.



How to Figure Investment-Age

End of Year	Invest., \$ × 10 ⁻⁶	Investment × Age, Dollars × Years × 10 ⁻⁶	Annual Maint., \$
1	7.5	(7.5 × 1) = 7.5	150,000
2	8.0	(7.5 × 2) + (0.5 × 1) = 15.5	250,000
3	8.5	(7.5 × 3) + (0.5 × 2) + (0.5 × 1) = 24.0	300,000

Forecast and Evaluate

At this point, a very basic question comes up: How general is this correlation? Is it just for pulp and paper mills or does it hold for all processing plants? Is it just for this one plant or for this company in general?

We're not sure. Perhaps there is a unique relationship for each type of process plant such as sulfuric acid, chlorine-caustic, etc. If so, a table of factors for these plants would be extremely useful.

Now, this is where you come in. For this correlation to be confirmed, we need your help.

First—We want to know if anyone has tried and/or is working with this correlation. If so . . . how well does it work?

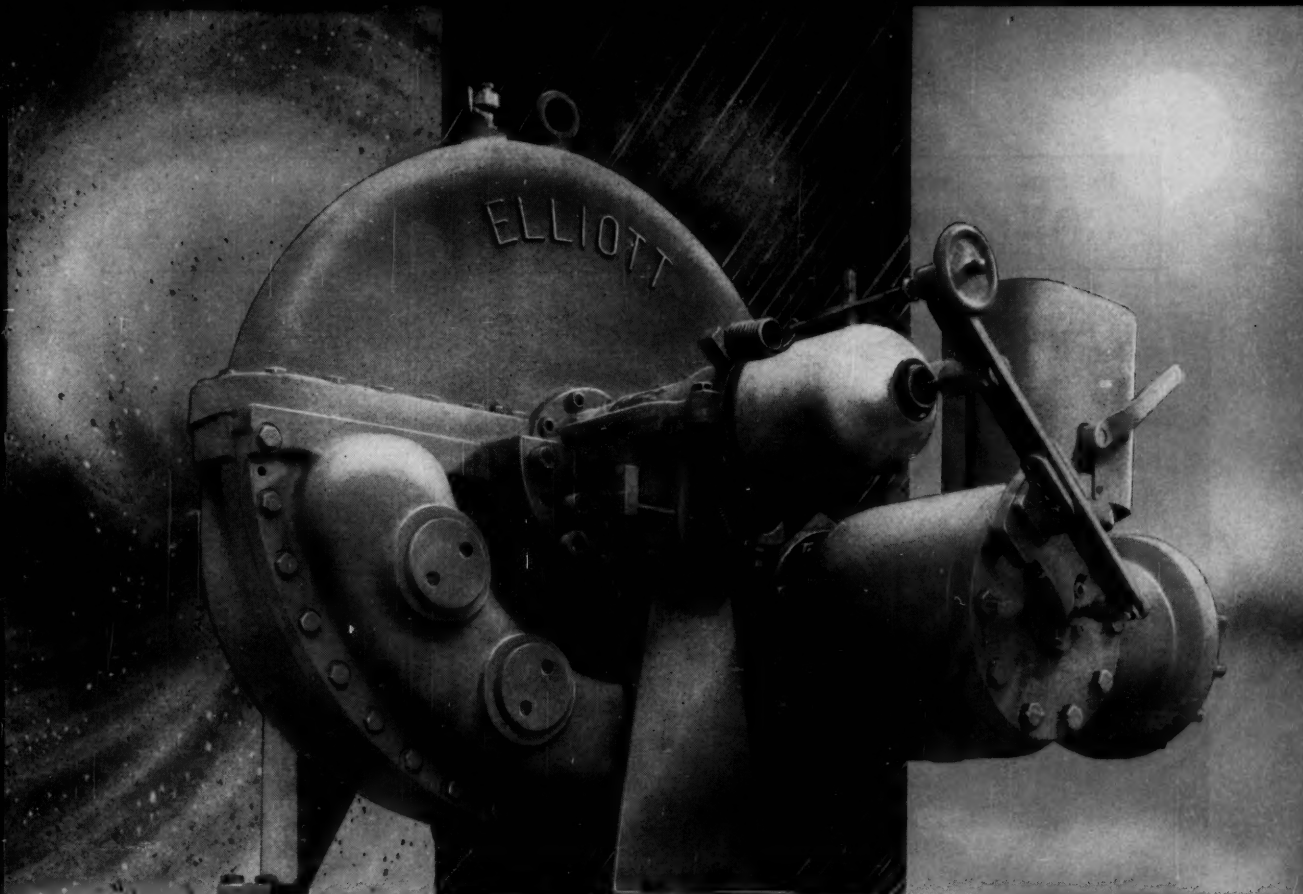
Then—We want you to try this method. See if your historical records give any basis of fact to this relationship.

Last—Let us hear from you. Send us your data and completed curves. If we receive enough of these, we can publish the results. Only then will you know if we have a valuable maintenance cost tool.

This can't be done without you.

Send your results and data to:

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Chemical Engineering
330 W. 42nd St.
New York 36, N. Y.



rugged and weatherproof

ELLIOTT YR TURBINES

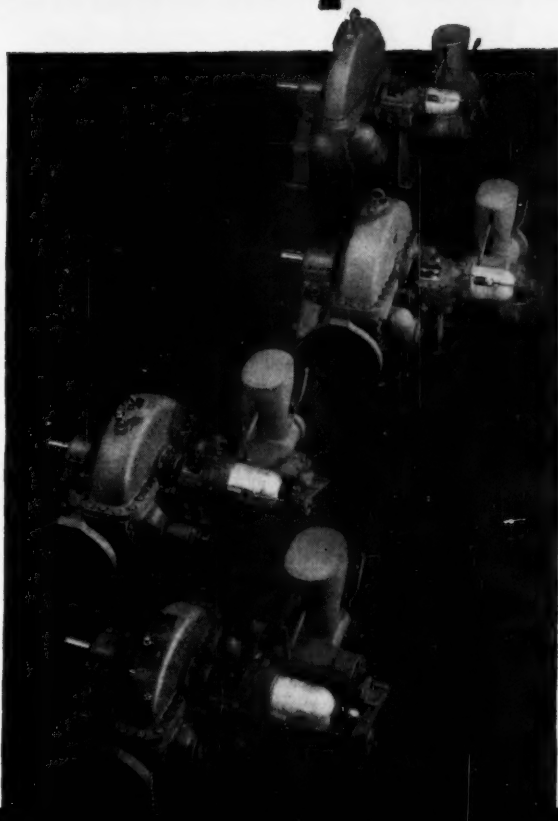
Desert heat, arctic cold, driving rain and swirling dust don't faze rugged, dependable Elliott YR Turbines. Tightly sealed against dust, fumes and moisture . . . built strong and husky . . . these machines make dependable, economical drives for pumps, compressors, fans, line shafts, generators and other equipment.

The governor is simple and reliable, and is available in several modifications to match speed and pressure control requirements. YR turbines are designed for easy installation and service. Many key parts are interchangeable for various frame sizes. Four sizes are shown at the right. Write for descriptive bulletin H22-C.

In addition to the units illustrated here, Elliott makes single-stage turbines in special frames, reduction gears, multistage mechanical drive turbines to 50,000 hp, and turbine-generators through 44 mw.



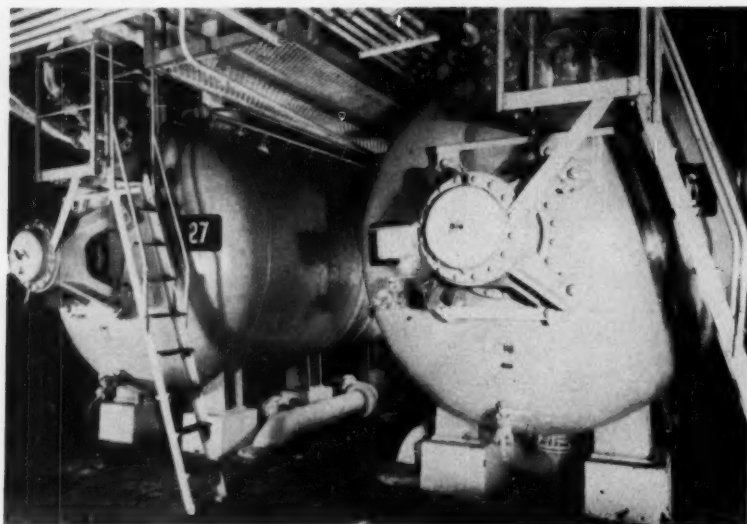
ELLIOTT Company
JEANNETTE, PENNSYLVANIA H9-2



PRACTICE ...

CORROSION FORUM

EDITED BY R. B. NORDEN



Reaction vessels, coated with urethane paint, at a Farbenfabriken Bayer plant in Germany.

New Urethane Coatings: Tops in Resistance

Take a look at the latest in protective coatings, the very promising urethane formulations. They're excellent against chemicals, abrasion.

If you walked up to a coatings expert and asked, "What's new in protective coatings?" the answer probably will be long and complicated. But chances are one word would be mentioned more often than any other. That word: urethanes.

For urethanes are the latest development in protective or maintenance coatings. According to many people these new coatings are a definite threat to established synthetics such as vinyls and epoxies as a protective covering on chemical equipment. **► German Development**—Developed in Germany during World War II, urethane coatings appear to have very good chemical resistance (Table III). And they have excellent abrasion resistance and hardness properties (Table II).

To get more specific: compared with vinyls, urethanes are more resistant to alkalis and sol-

vents; as good against acids and water; better in heat durability, abrasion and wear resistance.

Compared against epoxies, urethanes are more resistant to acids and water; as good in alkalis and solvents; better in abrasion and wear resistance.

Even these claims are really generalities. And for a good reason. They are based mainly on laboratory or small-scale tests, and a limited number of field tests. The data of Tables II and III only give a rough indication of wear and chemical resistance. Germany is passed the laboratory test stage,* but U.S. developed coatings, while similar, are not duplicates of the German materials. A number of chemical and petroleum companies (Du Pont, Monsanto, Warren Petroleum) have the U.S. coatings under

* In Germany urethane coatings have been in commercial use on chemical equipment for over ten years, mainly with excellent results.

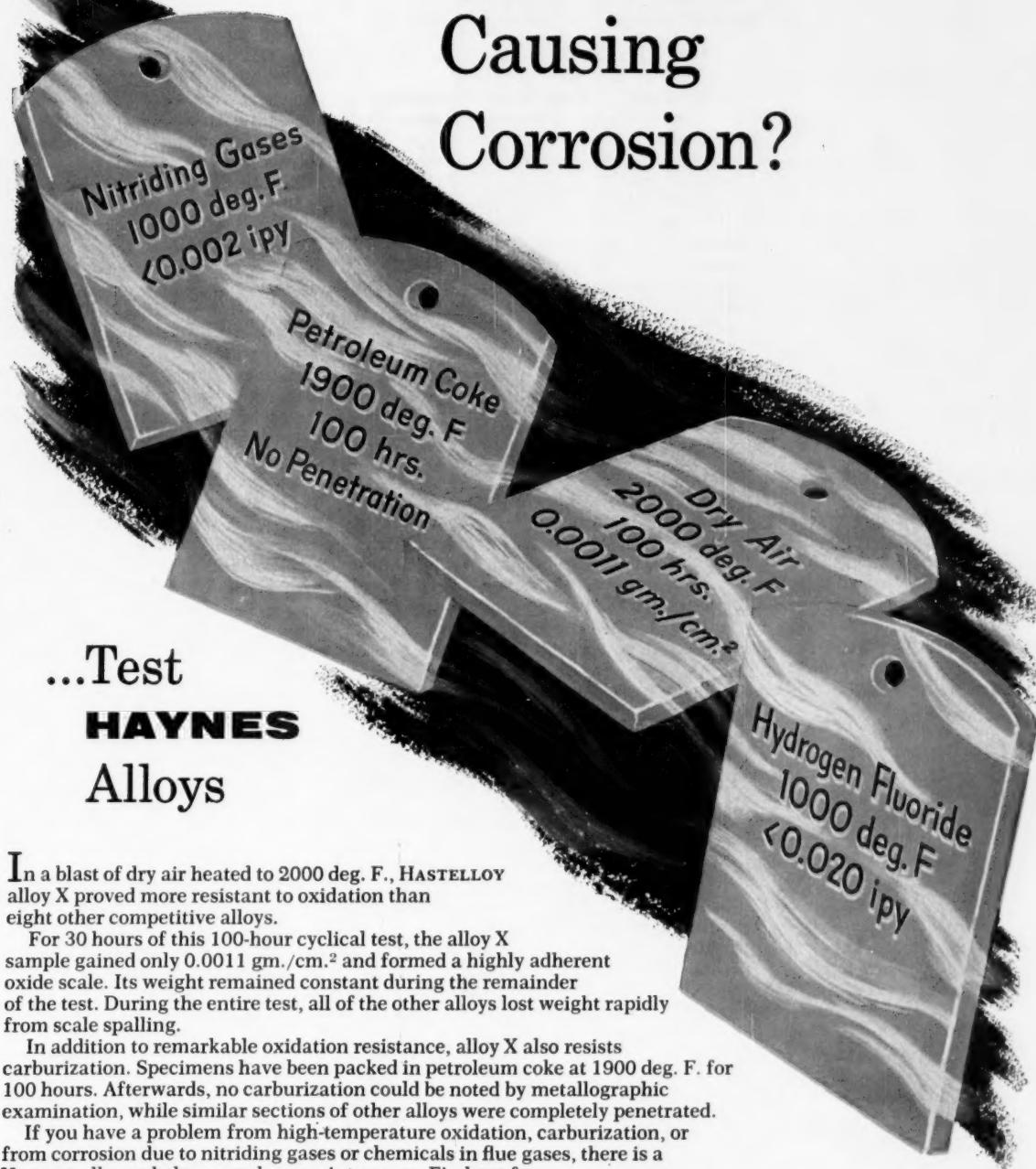
plant evaluation—results of this program are just coming in.

Coated concrete floors are holding up particularly well in chemical and wear service. And coated solvent tanks, chemical reactors all look good.

A urethane coating is produced by the polymerization reaction between polyfunctional isocyanates and resins containing hydroxyl groups (usually polyesters).

► Big Three—Three raw materials producers are the big guns in this field—Mobay Chemical, Du Pont and National Aniline. They don't make coatings (although Du Pont is planning to enter this area). All three work closely with paint companies. However, Mobay is the only producer of the two materials needed for the coatings—*isocyanates* and *polyesters*. Du Pont and National Aniline just make *isocyanates*. And it's generally agreed

Hot Gases Causing Corrosion?



...Test **HAYNES** Alloys

In a blast of dry air heated to 2000 deg. F., HASTELLOY alloy X proved more resistant to oxidation than eight other competitive alloys.

For 30 hours of this 100-hour cyclical test, the alloy X sample gained only 0.0011 gm./cm.² and formed a highly adherent oxide scale. Its weight remained constant during the remainder of the test. During the entire test, all of the other alloys lost weight rapidly from scale spalling.

In addition to remarkable oxidation resistance, alloy X also resists carburization. Specimens have been packed in petroleum coke at 1900 deg. F. for 100 hours. Afterwards, no carburization could be noted by metallographic examination, while similar sections of other alloys were completely penetrated.

If you have a problem from high-temperature oxidation, carburization, or from corrosion due to nitriding gases or chemicals in flue gases, there is a HAYNES alloy to help you reduce maintenance. Find out for yourself by testing them.

We'll gladly send you samples. But to make sure we send you the alloy or alloys most nearly suited to your need, we ask that you send a letter outlining your own particular conditions. If you would like to learn more about alloy X, ask for a copy of the booklet, "HASTELLOY Alloy X."

HAYNES ALLOYS

HAYNES STELLITE COMPANY

Division of Union Carbide Corporation
Kokomo, Indiana



The terms "Haynes," "Hastelloy," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

There Are Five Basic Types of Urethane Coatings—Table I

Package Type	Method of Cure	Type of Cure	General Chemical Resistance	Pigmented?
1	Air-dry	Same as drying oils	Fair	Yes
1	Air-dry	Atmospheric moisture for drying	Fair	No
1	Bake	Reaction of components	Excellent	Yes
2	Air-dry	Reaction plus atmospheric moisture	Good	No
2	Air-dry	Reaction of components	Excellent	Yes

that Mobay is the dominant company in coatings for corrosive service, usually called maintenance coatings.

Actually, what are these urethane coatings? First it's important to understand there is no one "urethane coating." Instead there's a complicated, interrelated family. Some members of this family are good for corrosive service, some not so good. It's vital to know what type of coating you—or the paint salesman—are talking about.

► **Five Classes**—To get down to cases, there are five major classes of urethane coatings (see Table I):

- One-package made from isocyanate-modified drying oils.

- One-package coatings made from urethane prepolymers. These "partial polymers" cure by reacting with moisture in the air.

- One-package bake-type coatings made from blocked isocyanates and polyfunctional hydroxyl-bearing resins. Blocking agents are driven off by heat.

- Two-package prepolymer coatings. Second package contains catalyst to speed up the reaction with air moisture.

- Two-package coatings made from (1) room-temperature reactive polyol-isocyanate adducts and (2) polyfunctional hydroxyl bearing resins.

► **Best in Its Class**—For maximum chemical resistance the two package isocyanate adduct-polyester system is best. Mobay

claims this system inherently gives a more resistant film. But another big factor: the system can be pigmented, which increases resistance. The two-package prepolymer arrangement cannot be pigmented, is only available as a clear coating. The baked coating is also very resistant, but can't be applied easily to large equipment in the field.

Even in the class of two-package coatings, complications come up. All are handled the same way: two separate packages must be blended just prior to application. After blending the mixture must be used within about 8 hr. (75F.). But there are a number of such two-package coatings, each with distinct properties.

This variety stems from the basic chemistry of urethanes. In

most cases the isocyanate is toluene diisocyanate (TDI). However TDI vapors, while not toxic, are highly irritating. They act as a lachrymator. But Mobay has come up with isocyanate adducts—the product of a reaction of polyols with TDI. The adducts still have reactive NCO groups, but they are nontoxic and do not irritate. (The one-package system, where TDI and polyesters are partially polymerized is another way of getting around TDI irritation).

► **Polyester Variety**—Polyesters offer another route to coating variations. These resins range from long linear structures to highly-branched ones, all terminated by hydroxyl groups.

When an isocyanate adduct is mixed with a polyester resin in a solvent, the NCO radicals react with terminal hydroxyl groups.

By proper selection of resin and amount of isocyanate, the properties of the urethane coating can be varied from extreme flexibility to extreme hardness. The more linear the polyester, the more flexible the film; the more branched, the harder and more chemically resistant the paint film.

► **No Cure-All**—Listening to some enthusiasts of these new coatings might lead you to believe urethane coatings are the answer to all corrosion problems. This is certainly not true. Urethane coatings have definite limitations and disadvantages.

The big disadvantage is cost. Quoting costs on paint systems is risky business, since price depends greatly on quantities, who is giving the largest discounts,

Coatings Are Hard and Wear Resistant—Table II

Coating	Sward Rocker Hardness ^a	Taber Wear Index ^b	Reverse Impact, In.-Lb.
Two-package urethane with highly-branched polyester	68	61	<4
Two-package urethane with moderately branched polyester	68	63	60
Two-package urethane with castor oil	48	60	>160
Chlorinated rubber	12	200	10
Epoxy	22	120	50
Vinyl	6	75	120

a. Glass = 100. b. Measures loss in wt./no. of cycles.



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Urethane Coatings Stand Up to Variety of Chemicals—Table III

	Two-Package Urethane (Highly-Branching Polyester)	Two-Package Urethane With Castor Oil	Epoxy With Polyamide	Vinyl
	Time to Coating Failure, Hr.			
20% HCl	50	20	20	50
10% H ₃ PO ₄	*	50	20	50
85% H ₃ PO ₄	50	190	1	290
10% H ₂ SO ₄	*	50	3	50
30% H ₂ SO ₄	*	70	3	*
5% HNO ₃	*	20	3	20
20% HNO ₃	30	20	3	20
5% acetic	310	30	3	20
20% acetic	20	20	1	20
10% NaOH	190	50	170	50
50% NaOH	400	6,300	*	550
5% NH ₄ OH	20	20	20	20
28% NH ₄ OH	20	20	20	20
KMnO ₄	70	50	20	50
Butyl acetate	4,000	1	20	1
Cyclohexanone	20	1	1	1
Methyl alcohol	1	1	3	3
Benzene	*	1	20	1
Carbon tet.	*	1	20	1

* All tests were carried out by dip-applying coatings on test tubes then curing the film for 7 days. Dry film was 1.0-1.5 mils thick. Coated test tubes totally immersed in chemicals listed. Table reports number of hours to failure. Where there is no number film was completely intact after 6,300 hr.

source, etc. But very roughly the two-package urethane system (separate isocyanate, polyester) runs between \$7.50 to \$12.50/gal. One-package urethanes will cost between \$4 to \$5/gal. Epoxies average \$6 to \$9/gal., vinyls \$5 to \$7.50/gal. Of course painting labor—which is the same for all types—is about 50% of the total cost of a large coating job, so the price differential isn't too serious. Nevertheless, urethane coatings are not materials you would use in a chemical plant when painting everything that doesn't move.

All but the baked urethanes don't stand up well against the lower alcohols, esters, ketones; or to oxidizing agents. Also, methylene chloride is an excellent solvent for these coatings.

There is an inherent disadvantage in the two-package system, since it is more difficult and cumbersome to work with, compared to a single can of paint.

And lastly, urethane coatings have a tendency to yellow under exposure to sunlight. On exposure to weathering they tend to chalk and lose their initial high gloss.

► **How To Apply**—But like the usual paint systems on the market, urethane coatings are formulated for easy application by conventional methods: spray, brush, roller or knife.

Adhesion of urethanes to wood, metal and concrete is generally excellent. Under severe corrosion exposures and immersion conditions, urethanes tend to lose adhesion on metal (particularly ferrous metals). Here good primer systems are recommended. Wash primers with good inhibitive pigments have been used.

► **On Metal**—For metal, best results are obtained when the coating system is applied to sand-blasted metal.

Apply one to two coats of primer to a dried film thickness of 1-2 mils per coat. The primer coat normally should be allowed to dry thoroughly for one day before applying top coats.

Apply two top coats of undiluted coating if application is by roller, brush or spray. If exposure conditions are severe, three top coats should be used. Each coat is applied in 1½ to 2 mils thickness. Optimum results are

obtained when the total coating thickness is at least 5 mils. Normally, a minimum 6 hr. air-dry is recommended between top coats.

If the metal parts are to be used in water service or immersed in chemicals or solvents, the finished surface should be allowed to air-dry at normal temperatures for at least three days before being put into service. Wherever possible, baking will further improve the resistance of urethanes to immersion conditions.

The coverage of urethane coatings will depend on the formulation which is used, the method of application and the condition of the surface over which they are applied. Coverage will vary from 300-750 sq. ft./mil/gal.

Now girding for a stiff competitive fight with established maintenance coatings, all three raw material producers for urethanes have lined up well-known, and some not so well known, paint companies to market the coatings. Mobay has a list of over 15 paint suppliers who have urethane coatings in commercial quantities.



PERMOBOND LININGS



252 metal cells are resistant to chlorine and chlorinated salt solutions

This plant of Olin Mathieson Chemical Corporation at McIntosh, Alabama, produces hundreds of tons of chlorine daily. Because chlorine and chlorine salt solutions destroy metal in a matter of hours, the 252 carbon steel cells used here are protected with U. S. Permabond® Linings S5471. This is a special compound of Permabond Linings that has been successfully used by producers of chlorine for the past several years to protect the metal parts in electrolytic amalgam cells. This same Permabond S5471 is the *right* lining for all chemi-

cal processors who use this highly corrosive basic chemical.

Any original equipment can be lined with Permabond before delivery. You can also have it put on existing equipment—*right in your own plant.*

United States Rubber Company maintains a field force of special sales engineers to give you the best and fastest help on your corrosion problems. Get in touch with any of our strategically located branches or write U. S. Rubber, Rockefeller Center, New York 20, N. Y.



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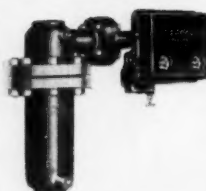
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Reducing Valve



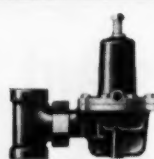
Type 630 "Big Joe"
Field Regulator



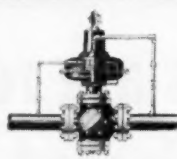
Series 99 Multi-
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Type 655-A Pres-
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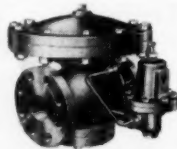
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In addition to the large factory stock, the Fisher offices in the column to the right which are starred carry a big selection of Fisher equipment in inventory to assist you.

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Phone, wire or TWX (Marshalltown 578 or 579) and Fisher will have your order en-route in a matter of hours, Saturday and Sunday excepted.

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Mechanical Valve & Engineering Spec.

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES

February's Top Projects:

Du Pont has everybody guessing about the capacity of the low-pressure polyethylene plant it is building at Orange, Tex. Using Du Pont's own process, plant is due on stream in mid-1960. Only clue to size: Unit will employ about 50 workers.

SunOlin is starting construction next month on its 73,000-ton/yr. urea plant at North Claymont, Del. The \$11-million plant will use Montecatini's total recycle process; engineering and construction will be handled by M. W. Kellogg.

Union Carbide is furnishing technical know-how for a new 30-million-lb./yr. polyethylene plant near Antwerp, Belgium, that will be producing by mid-1960. Partner in the project will be Belgium's Petrochim organization; this is Carbide's third venture in European polyethylene facilities.

American Chemical Corp., owned by Stauffer and Richfield Oil, is constructing a \$7.5-million petrochemical complex at Watson, Calif., with completion slated for January 1960. Major products: Ethyl chloride, ethylene dichloride and vinyl chloride monomer.

Standard of California will add a polymerization unit to the 55,000-bbl./day catalytic cracking plant under construction at the Richmond, Calif., refinery. Together with alkylation and isomerization units already under construction, new units bring total project cost to \$30 million.

Monsanto is building a new plant at Nitro, W. Va., to make Mersize, a chemically fortified pale rosin size used by paper makers to impart water resistance to paper and paper board. A similar unit is already under construction in Seattle, Wash., to serve Northwest markets. Unit will process tall oil rosin from an adjacent fractionation plant (*Chem. Eng.*, Aug. 25, 1958, pp. 58-60).

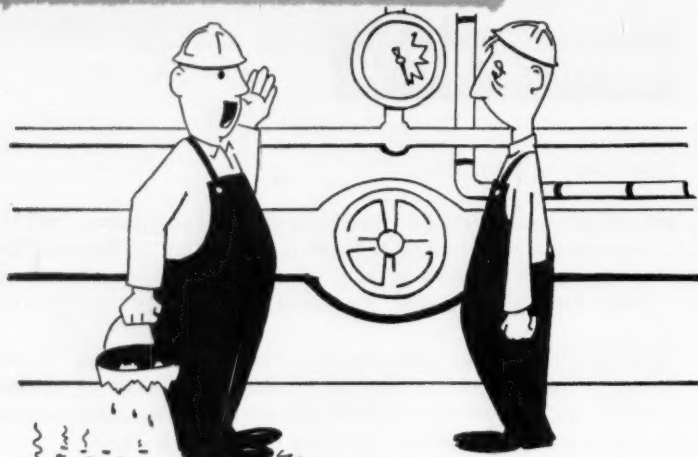
Bay Petroleum will increase capacity of its New Orleans re-

finery from 25,000 bbl./day to 33,000 bbl./day through installation of a new two-stage distillation unit due on stream in early 1960. Bay is also installing a 2,700-bbl./day alkylation unit, improved gas recovery facilities and 200,000 bbl. of crude and product storage.

U. S. Phosphoric Products (Div. Tennessee Corp.) is building a plant at East Tampa, Fla., to make modified diammonium phosphate via a "unique process" developed by the company. New plant, with design capacity of 100,000 tons/yr., is due on stream April 1, 1959.

Union Carbide has awarded the construction contract for its new ore dressing plant at Newport News, Va., to Tidewater Construction Corp. Plant, scheduled for comple-

Life in these excited states ...



"I said, I borrowed a pail of acid... O. K.?"



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Choice of Rivclor PVC, Ace-ite rubber-plastic, Ace polyethylene or Ace Saran to match any plastic pipe. Sizes $\frac{1}{2}$ to 2". Also larger plastic-lined valves.

Time Can't Be Borrowed Either

Equipment running on borrowed time due to corrosion has a knack of dropping the bottom out of production when you can least afford it. No need to risk it... just specify Ace chemical resistant equipment. Best for the money anywhere... backed by 108 years' experience.



Ace-Hide, tough as a rhinoceros, insensitive to corrosives, makes this finest of acid pails. Also dippers, bottles, funnels, etc.



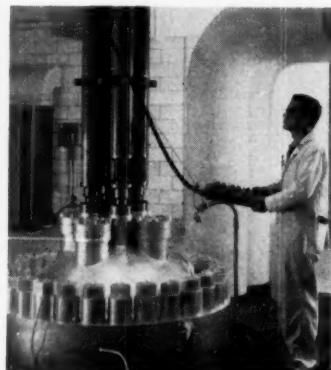
ACE

processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey

FIRMS...

tion by May 1, 1960, will grade and classify about 30,000 tons/mo. of manganese ore—which will then be shipped to other plants of Union Carbide Metals Co.



Phillips Petroleum is operating the AEC's new Special Power Excursion Reactor Test No. 3 (SPERT-III) at Idaho Falls, Idaho. Built at a cost of \$3.5 million, facility will try to find basic explanations for reactor behavior under runaway conditions. Operator above is checking out the reactor control rods.

Armstrong Cork Co.'s Dunkirk, Ind., glass plant is undergoing the second expansion in less than a year: Included in new project are a large glass melting furnace, forming machines and packaging equipment. Production capacity will be upped around 50%.

Georgia Pacific Alaska Co., Portland, Ore., has applied for benefits under Alaska's industrial tax incentive act for firm's proposed \$50-million pulp and newsprint mill on Douglas Island. Amounting to 10 years' exemption from state taxes, granting of the application would be a "major incentive" for the company to go ahead with its plans—which call for mill to be in production by 1965.

Koppers announces it will start construction in 1959 on a new research center at Monroeville, Pa. Initial construction will provide an administra-

tion building, three chemical laboratories, a power plant and supporting facilities.

Atomic Energy Commission has dedicated the nation's newest atomic medical research center, including world's first nuclear reactor designed specifically for medical use, at Brookhaven National Laboratory, Upton, L. I., New York.

Atlas Powder Co. is building a new laboratory for expanded research on activated carbons at the present site of its Darco experimental laboratory near Marshall, Tex. Facility will cost about \$500,000 and will be completed in July.

High Voltage Engineering Corp. is expanding its Burlington, Mass., production facilities by 20%. Part of the 20,000 sq. ft. addition will be used for assembly of firm's line of 10-Mev. tandem Van de Graff accelerators.

Harbison-Walker Refractories Co. has opened the doors of its new research center in Pittsburgh, Pa. Center's 45,000 sq. ft. of floor space includes research laboratories and a complete pilot plant for applied research.

Washington State College's Dept. of Chemical Engineering has acquired a new liquid metal heat transfer unit under a \$30,000 grant from the AEC. Students will use it to study heat transfer and flow characteristics of liquid metals used in extracting heat from nuclear reactors.

Great Western Chemical Co. is spending \$250,000 for construction of an office and warehouse building, as well as expanded bulk handling facilities, at Seattle, Wash. Started three years ago, the company distributes industrial chemicals and allied products to Northwest industries.

Tidewater Oil will operate the new pilot plant in the New Hope area of Franklin County, Tex., to test the

Life in these excited states...

"I can't stand that constant drip-drip-drip!"



Corrosion got the drop on you?

Little drips can mean big losses... repairs, downtime, ruined equipment. You can put an end to 85 to 100% of these problems with Ace chemical-resistant rubber and plastic piping, valves, pumps, tanks and other equipment. American Hard Rubber Company's 108 years of experience is at your service.

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*

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for ageless strength



Improved design... now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*

NEW
ACE Gear Pump



Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57*

SUPPLEX
tops in economy



World's best chemical valves... at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ½" pet cocks to 24" gate valves.

VALVE HEADQUARTERS



ACE

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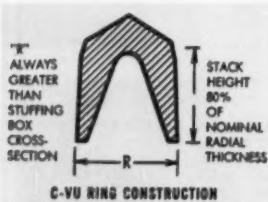
ACE

See our pages
in
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Catalog!

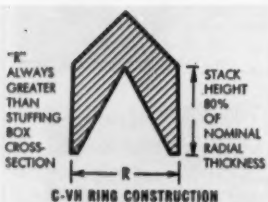


It will effectively handle all industrial acids, alkalis, solvents, organic and hydraulic fluids . . . temperatures from -120°F. to $+500^{\circ}\text{F.}$. . . is equally suited to valves, pumps, mixers, hydraulic cylinders and like equipment.

Countless successful applications of C-V Rings under the most severe service conditions have made this the closest approach to a universal packing . . .



C-VU RING CONSTRUCTION



C-VH RING CONSTRUCTION

this take-up room minimizes any excess friction in the stuffing box. "John Crane" C-V Rings are available in full line of standard sizes and male and female adaptors. Sizes can be molded to stuffing box specifications.

Request Bulletin P-325.

*"John Crane" C-V Rings are made from Chemlon—the best in DuPont Teflon.

Crane Packing Co., 6451 Oakton St., Morton Grove, Ill. (Chicago Suburb). In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

TWO STYLES ARE AVAILABLE:

C-VU RINGS for low pressure service—such as control and regulator valves handling gases and fluids, where it is necessary to have a very sensitive and resilient type packing.

C-VH RINGS for high pressure service—for use in pumps, hydraulic cylinders and like services at pressures ranging to 500 psi. and over. These rings are constructed with a heavy wall heel to withstand pressure requirements. They are designed to provide voids between rings, so that as the Teflon expands due to heat,

FIRMS . . .

Townsend process for recovering sulfur from sour gas. Unit will treat sour gas at 1,800 psi. containing 15% H_2S ; Tidewater is working in conjunction with Hudson Engineering Corp.

American Petrofina has placed a new Platformer on stream at its El Dorado, Kan., refinery as part of the drive towards higher octane gasoline. Licensed from Universal Oil Products, the Platformer was engineered and built by Petrofina engineers.

West Virginia Pulp & Paper Co. is equipping a second machine at its Charleston, S. C., mill to make Clupak paper (*Chem. Eng.*, Mar. 10, 1958, p. 84). With both units in operation, West Virginia will be able to supply 150,000 tons/yr. of the stretchable paper.

Esso Petroleum Co. (England) has opened its new \$28-million petrochemicals plant at Fawley, Essex, with an annual capacity of 42,000 tons butadiene and 40,000 tons ethylene. New plant is a major step in Esso's plan to become self-sufficient in refined products for the U.K. market.



Johns-Manville becomes the second largest fiber-glass producer in the nation (in annual sales) through acquisition of L. O. F. Glass Fibers of Toledo, Ohio. J-M takes over seven fiber glass plants and a research center at Waterville, Ohio. Capacities of the plants at Waterville, Corona, Calif., and Defiance, Ohio, will be increased immediately.

Anaconda is girdling for stepped-up activity in the aluminum markets through a merging of American Aluminum Co. and Cochran Foil Corp. (both wholly owned sub-



sidiaries) into Anaconda Aluminum Co. Sweeping organizational expansion is designed to form a company embracing every phase of aluminum production — from reduction through final fabrication. As-sets of the new company total well over \$140 million.

Northwest Refining & Chemical Co. has acquired the Admiral zinc mine located in northern Stevens County, Utah, giving firm its own supply of zinc ore for making zinc oxide. Northwest has developed its own process for oxide manufacture (*Chem. Eng.*, Dec. 15, 1958, pp. 78-80).

Texas Instruments and Metals & Controls have reached agreement "in principle" on a proposed merger. Merger of M & C into Texas Instruments through a stock exchange is still subject to stockholder approval.

Olin Mathieson has sold its majority interest in Hunter Engineering Co., Riverside, Calif., to Joseph L. Hunter who becomes sole owner. Firm, a manufacturer of aluminum sheet, strip and extrusions, will continue to do research for OM.

Diversey Corp. of Chicago, manufacturer of chemical products and detergents for industrial use, acquired its fifth company in a year with the purchase of Deosan Ltd., of London, Eng. Purchased for \$800,000 from Vick International, Deosan's activities in England closely parallel those of Diversey in the U.S.

Hercules Powder Co. is buying the Young Development Laboratories of Rocky Hill, N. J., a manufacturer of filament-wound, glass-fiber-reinforced plastics. Firm has been working with Hercules on rocket motors for solid propellants for almost ten years, using reinforced plastics to withstand the heat and pressures of rocket engines.

Eaton Mfg. Co. is acquiring the assets and business of Cleve-



**the most
economical
inert gas**

Carbon dioxide is a truly versatile chemical: a solid or liquid refrigerant . . . a pressure-producing and carbonating agent . . . a chemical that reacts with a select number of substances . . . and, in apparent contradiction to its chemical uses, a low-cost inert gas with a wide range of applications, many of which have hardly been exploited. These inerting applications, in fact, may well eventually overshadow the generally accepted ones. Although CO₂ cannot be used in *all* inert gas applications, it can be used in many cases just as effectively as the more costly and less easily handled "elemental" inert: argon, nitrogen, etc.

FOR EXAMPLE, HERE ARE JUST A FEW CO₂ INERTING USES:

Blanketing explosives and combustibles . . . solvent dewaxers . . . alkyd resins (while also providing sufficient pressure for agitation) . . . within vessels to eliminate oxidation, skinning or bacterial growth from such materials as paints, varnishes, tall oils, etc.

Purging vessels prior to filling with special materials . . . lines, holders, tanks, etc., while under storage or being emptied . . . hydrogen-filled generators during repairs . . . gasoline and oil tanks, etc., under repairs.

Pressure transference of combustibles of all types without pumps.

Shielding welding arcs.

Reducing fire and explosion hazards while materials undergo grinding and pulverizing. CO₂ also reduces temperature of materials prone to soften during these operations.

Mathieson CO₂ comes in a variety of forms and quantities ranging from 50-lb. cylinders and dry ice to 24- and 30-ton tank cars for direct unloading to your process. Why not contact an Olin Mathieson representative soon for an informative discussion? CO₂ may offer you important savings or process improvements.

HERE ARE SOME OF THE IMPORTANT CHARACTERISTICS OF CO₂ VAPOR

Molecular weight	44.004
Specific Gravity	1.527 (when air equals 1)
	1.557 (when N ₂ equals 1)
Absolute density	0.114 lb/cu. ft. @ 70° F.
Thermal conductivity	0.590 (air equals 1)
Specific heat	0.19 to 0.21 BTU/lb
Volume, cu. ft./lb	8.79 @ 70° F.
Pressure, saturated	852.5 psia @ 70° F.
Cost, 100 cu. ft.	\$0.455 (CO ₂ costing \$.04/lb)



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OLIN MATHIESON CHEMICAL CORPORATION
CHEMICALS DIVISION • BALTIMORE 3, MD.

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get **MORE** vacuum pumping
per dollar ... *plus**

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- * **Quiet**—for service anywhere, lab or plant
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To support every Stokes customer—we offer a complete application engineering advisory service of trained vacuum specialists. Write for complete literature or application assistance on all models.

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F. J. STOKES CORPORATION
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STOKES

FIRMS...

land Worm & Gear Co., Cleveland, Ohio. Cleveland Worm & Gear will now be operated as a wholly-owned subsidiary of Eaton.

Haynie Products, Wildwood, N. J., is organizing an integrated fish oil processing operation through the acquisition of Menhaden Fish Products, Baltimore, Md. New organization has facilities for research, catching, processing and marketing refined oils.



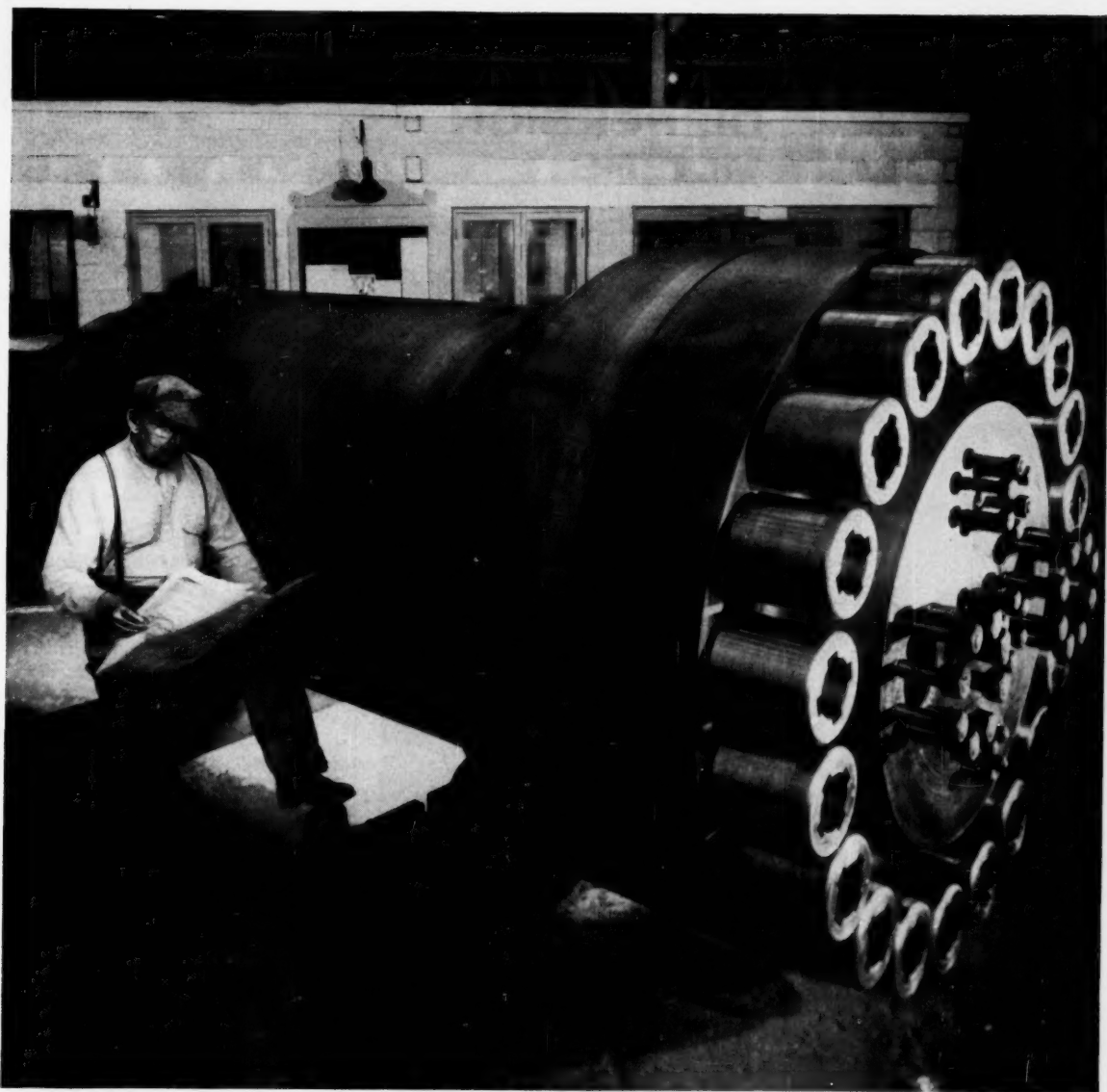
NEW COMPANIES

Mallinckrodt Chemical Works is establishing a separate company, Mallinckrodt Nuclear Corp., to carry out its privately owned nuclear fuels business. Mallinckrodt Nuclear, a wholly owned subsidiary, is taking over the facilities of the Special Metals Div. including the \$2-million nuclear fuel plant at Hematite, Mo.

Olin Mathieson and Textron, Inc., have formed a jointly owned company — Almetco, Inc.—to produce aluminum extrusions for the two firms. New company will own and operate extrusion plants formerly owned by Textron at Girard, Ohio and Nesquehoning, Pa.

General Aniline & Film and Douglas Aircraft have formed a new company, DataGraphic Systems, Inc., to develop new techniques, processes and systems in the microfilm and reproduction field. One objective is to make stored microfilm files more accessible and thereby more useful.

General Controls Co. has established a European subsidiary with headquarters in Dusseldorf, West Germany. Company will act as sales and distribution center for continental Europe with eventual



Separator Ready for High-Pressure Service

Here's another Bethlehem forged pressure vessel ready for shipping. It's getting a final check before the shops send it on its way. This is a 45-ton separator with an ID of approximately 4 ft. Unusually rugged throughout, the unit is built to last for years in high-pressure service.

Bethlehem's integrated shops are equipped to handle every step in the building of forged vessels. All sizes can be furnished, from slim pulsation bottles to giant converters weighing 150 tons and more.

When you are planning new separators, autoclaves, filters,

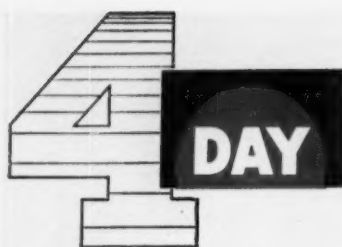
reactors, converters, or accumulators, our technical men will be glad to work closely with you. They are thoroughly familiar with the types of forged vessels used in the chemical, rubber, petroleum, and other industries. Once the details have been settled, Bethlehem shop personnel will meet specifications in every particular.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL



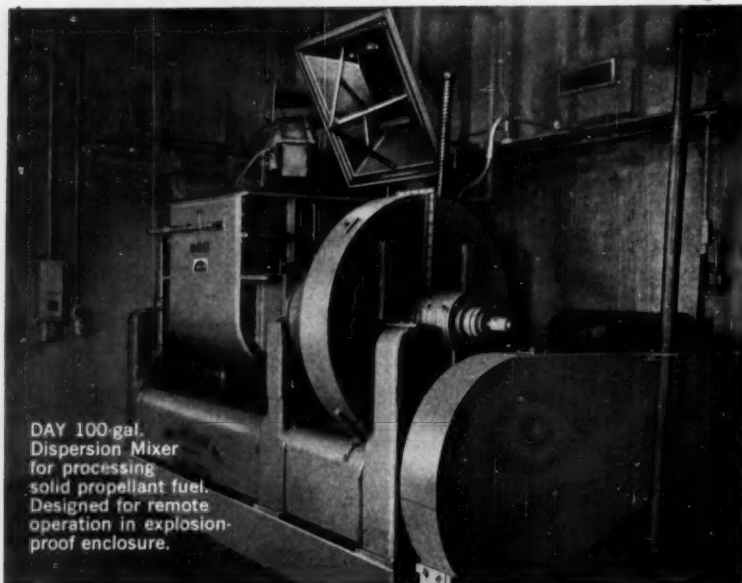


DISPERSION MIXERS

PROCESS

Solid Propellant Fuel

AT AMOCO CHEMICALS CORP.



DAY 100 gal. Dispersion Mixer for processing solid propellant fuel. Designed for remote operation in explosion-proof enclosure.

Above is one of the four DAY Dispersion Mixers that process solid propellant at the Seymour plant of Amoco Chemicals Corp., Division of Standard Oil Company of Indiana. Amoco Engineers selected new DAY equipment because of the many unique design and construction features incorporated into these mixers for this exacting work. Typical features—

- Rugged Construction
- Tank is Stainless Steel and Jacketed
- Blades are "Z" Type and Cored
- Close Temperature Control
- Protected by Safety Devices
- Can Mix Under Vacuum
- Cover Air-Cylinder Operated
- Cover has Over-Pressure Release
- Stuffing Boxes Protect Bearings and Mixture
- Motorized Dumping Mechanism

Amoco's personnel express complete satisfaction in the safety, ruggedness and thoroughly dependable performance of these DAY Dispersion Mixers. Investigate the many proven advantages of these mixers for your production. Available in a complete range of laboratory and production sizes: 1/4 to 300 gallon capacities, 3/4 to 150 hp. drives. Write for detailed information.

For other DAY equipment, see our insert in Chemical Engineering Catalog

The J. H. DAY Co.

Division of The Cleveland Automatic Machine Co.

QUALITY MIXING, BLENDING, MILLING AND SIFTING MACHINES SINCE 1887.

4926 Beech Street, Cincinnati 12, Ohio

FIRMS . . .

expansion of these functions to England.

Houston Instrument Corp. has been organized to develop, manufacture and sell laboratory instruments and specialized industrial instruments for chemical and petroleum industries. Address: 1717 Clay Ave., Houston 3, Tex.

Armstrong Cork Co. is combining all of its activities outside the U. S. into a single organization to be known as International Operations. New organization includes the old Export Div., Armstrong Panam Corp. and the Lancaster staff of the company's foreign operations.

Smith Kline & French has established an independent research organization in Great Britain to supplement firm's Philadelphia research activities—and to provide a link to European science. Labs will be erected near London.



NEW LOCATIONS

Pioneer Plastics, manufacturer of polyethylene labware and specialty molders, has moved to a new and expanded plant on Atlantic Blvd. in Jacksonville, Fla. Mailing address: Box 8066, Arlington Branch; Jacksonville 11, Fla.

Pan American Sulphur Co. has moved its main offices from Dallas to 609 Bank of the Southwest Building, Houston, Tex.

Eastman Chemical Products, subsidiary of Eastman Kodak, has created a new southern sales territory with offices at 435 Jefferson Standard Building, Greensboro, N. C.

General Gas Corp. and its wholly owned subsidiary, Delta Tank Mfg. Co., have moved into new joint executive offices at 300 Laurel St., Baton Rouge, La.

BRIEFS

on the many, many forms of NIALK® caustic potash... a new sulfide drum that empties much faster... how to get 99.8% pure oxalic acid... two different grades of benzoic acid... phosphoric anhydride as a desiccant

Wet or dry How do you like your KOH?

If you're one of the relatively few people who prefer caustic potash in the solid state, we can provide you with any of these seven forms, all at 90% KOH:

- | | |
|-------------|-----------|
| 1. Solid | 4. Walnut |
| 2. Flake | 5. Broken |
| 3. Granular | 6. Powder |
| 7. Crushed | |

If one of these won't do, we can ship you 85%-strength KOH of even higher purity, in flake or solid form.

If you prefer your caustic potash liquid (it's generally cheaper and easier to handle), you can get it from us in concentrations between 45% and 52%, delivered in 55-gallon drums, tank cars of 4,000-, 6,000-, 8,000-, or 10,000-gallon capacity—or in duplex tank cars holding 3,000 gallons per compartment.

Is all this fuss worth while over a specialty alkali like caustic potash?

Well, our customers tell us it is. And they buy, under the NIALK® label, about half the caustic potash sold in this country.

We hope you'll think so, too.

Sulfides in new drum easier to empty or re-use in your plant



Your operators will like the convenience of this new 400-lb. drum in which you can now purchase Hooker sodium sulfide and sodium sulfhydryte.

The opening is 18 inches in diameter

—four inches wider and 65% larger in area than the former container.

This drum is much easier to empty with a scoop or shovel. It saves time and is safer when pouring, too. Flakes don't pile up around the opening when drum is inverted.

You'll also like the way this drum safeguards the exceptionally low iron content of our sulfide or sulfhydryte until you're ready to use it.

Only brand-new drums are shipped; none are re-used. A lacquer lining prevents iron pickup during shipping and storage. Six lugs hold the lid on tight, and let you reseal the drum to protect any unused product.

There's no increase in price for the new drum. To get its extra convenience and safety, just specify Hooker sodium sulfide or sodium sulfhydryte on your next order.

99.8% pure oxalic acid

We make an oxalic acid that's about as pure as any you'll find outside a lab. We sell it under the brand name OLDBURY®.

A typical assay shows 99.8% purity. You can get this chemical in two pure-white crystal sizes—No. 2 fine and No. 3 fine.

Both are packed in 100-lb. and 300-lb. Leverpak containers.

Send for data sheet Keep your technical file up to date by adding to it a copy of our latest publication on Oldbury oxalic acid: Data Sheet 789.

This data sheet lists specifications, physical properties, packing data, and

various handling precautions.

Just check and send the coupon below for a copy.

Benzoic acid in new crystal form

Customers told us there were three ways to improve benzoic acid. Make it dissolve faster. Make it freer flowing. Get rid of irritating fines.

We've done all three with a new Crystal Benzoic Acid.

Both the crystals and a powdered form are available in two grades. U.S.P. grade assays 99.3% min.; technical grade is 98.0% pure. Both grades have 0.2% max. water content.

Check the coupon for more data on benzoic acid and its chemical cousin, sodium benzoate, which we also supply in U.S.P. and technical grades.

What do you want to dehydrate?

If you have a drying problem, don't overlook phosphoric anhydride, P₂O₅. This OLDBURY product is one of the strongest known desiccants.

A white fluffy powder assaying 98% min. P₂O₅, it contains no sulfate. This is an important advantage in one of its major uses—as a condensing agent in making clear methacrylate resins.

If you're interested in phosphoric anhydride for a present or a potential use, just check the coupon for more complete information.

For more information on chemicals mentioned on this page, check here:

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| <input type="checkbox"/> Sodium Sulfide | <input type="checkbox"/> Sodium Benzoate |
| <input type="checkbox"/> Sodium Sulfhydryte | <input type="checkbox"/> Phosphoric Anhydride |
| <input type="checkbox"/> Oxalic Acid | <input type="checkbox"/> New list of products—
Bulletin 100-B |

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CALENDAR

American Institute of Mining, Metallurgical and Petroleum Engineers, annual meeting, St. Francis, Sheraton-Palace and Sir Francis Drake Hotels.
Feb. 15-19 San Francisco, Calif.

Lehigh Valley Chemical Engineers Club, Topic: Radioactive Tracers in Process Control, The Chapman Restaurant.
Feb. 16 Bethlehem, Pa.

Chemical Market Research Assn., meeting topic: Chemicals for the Textile Industry, Dinkler Plaza Hotel.
Feb. 18-19 Atlanta, Ga.

Chemical Institute of Canada, Protective Coatings Division, annual conference.*
Feb. 19 Toronto, Ont.

Chemical Institute of Canada, Protective Coatings Division, annual conference. *(duplicate program)
Feb. 20 Montreal, Que.

Technical Assn. of the Pulp and Paper Industry, 44th annual meeting, Commodore Hotel.
Feb. 23-26 New York, N. Y.

National Assn. of Corrosion Engineers, annual meeting and exhibition, Sherman Hotel.
March 16-20 Chicago, Ill.

American Society for Metals, 11th Western Metals Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel.
March 16-20 Los Angeles, Calif.

American Institute of Chemical Engineers, Philadelphia-Wilmington Sections, Symposium: Experience in Industry, University of Pennsylvania.
March 31 Philadelphia, Pa.

American Institute of Mining, Metallurgical and Petroleum Engineers, Technical Conference: Stress Corrosion, Mellon Institute.
April 2-3 Pittsburgh, Pa.

American Chemical Society, annual national meeting.
April 5-10 Boston, Mass.

Nuclear Congress, coordinated by the Engineers Joint Council, Public Auditorium.
April 5-10 Cleveland, Ohio

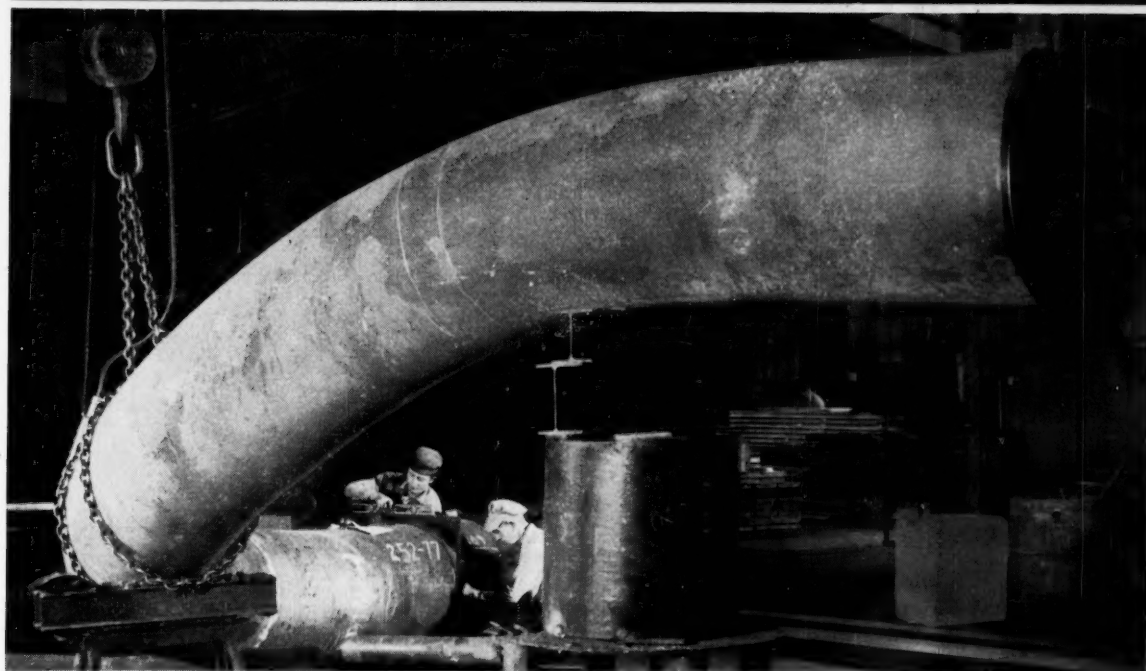
Instrument Society of America, Second National Symposium on Chemical and Petroleum Instrumentation.
April 6-7 St. Louis, Mo.

American Institute of Mining, Metallurgical and Petroleum Engineers, 42nd national Open Hearth Steel Conference and Raw Material Conference, Jefferson Hotel.
April 6-8 St. Louis, Mo.

American Institute of Chemical Engineers, Ohio, Pittsburgh and West Virginia Sections, annual symposium: Catalysis, Mellon Institute.
April 10 Pittsburgh, Pa.

Engineering, Marine Welding and Nuclear Energy Exhibition.
April 16-30 Olympia, England

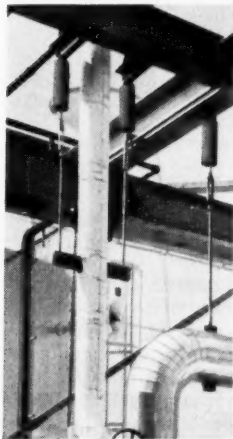
BLAW-KNOX has what it takes—to provide these products and services



Large chrome moly pipe being readied for shipment to new generating station. Making a right angle bend followed by a 24 degree, 18 foot bend in this heavy 27½ inch chrome moly pipe required all the skill and modern facilities of the Blaw-Knox power piping shop. Before shipment, piping is heat-treated and ultrasonically tested with a radar-type device for detection of any defects.

A new Blaw-Knox "6 x 6" Flexibility Matrix Method

of computing stresses in power piping systems is now available to consulting engineers, companies, and individuals responsible for the design of power piping systems. By the use of an electronic computer this method cuts calculating time from months to a day; assures full accuracy to six significant figures; and has no limitations on the complexity of the system. Write for further information about our new "6 x 6" Flexibility Matrix Method.



Two-way control over movement of piping is provided by Blaw-Knox functional spring hangers with the patented internal swivel action—shown in this modern outdoor generating station. Our experienced engineers are available to both design and make recommendations for your hanger requirements. To get full information, write for Catalog No. 54.

Each year serious fire strikes one out of every seven manufacturing firms in this country. Be safe. Let a Blaw-Knox fire-protection engineer study your needs—and explain how you can pay for the system on our lease or deferred payment plan. To get more information send for Bulletin No. 2426—"Fire Can Destroy Your Business."



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Power Piping and Sprinkler Division
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Complete facilities for prefabrication and erection of piping systems for all pressures and temperatures
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... complete line of automatic sprinkler systems for standard and special hazards

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WALLS

WIDE
REINFORCING
BANDS

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WALL
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PERMANENT
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AND
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TRUE
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Special non-standard
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Also available—150 lb. screwed fittings
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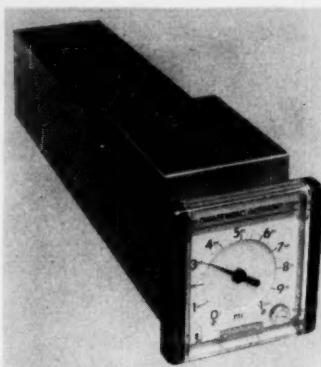
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WEST COAST AGENT
AND WAREHOUSE

J. J. GATELEY CO.
8283 Baldwin Street
Oakland 21, California

NEW EQUIPMENT . . .

(Continued from p. 92)



Digitizer

Converts analog signal to
digital code.

A new device that operates on 0 to 0.5-v. a.c. inputs translates analog signals from any of the manufacturer's Autronic transmitters or converters into a digital code. Called the A9M Indicating Digitizer, the device has a large dial that gives a continuous indication of process variables. Output will also meet input requirements for the programming of computer tapes or cards, for telemetering, and the like.

Optional accessories include high and low alarm contacts. A9M is housed in one of the manufacturer's standard cases that fit into 5-in.-square panel cutouts.—Swartwout Co., Cleveland, Ohio. 162A

Process Monitor

Gives alarm if variables
deviate from standard.

Alarm Scanner, a new panel-mounted monitoring system, automatically scans several hundred process measurements at speeds up to 5 points per second. The scanner is particularly applicable when warnings of critical high or low variable values are essential.

In scanning a measurement point, the system compares the output voltage of a thermocouple or other sensing element with a reference voltage. The reference voltage, which is preset on a pinboard, corresponds

to the permissible high or low valve of the process variable. An "alarm" condition causes actuation of visible and audible warnings. An alarm printer, giving time and point number, is optional.—The Foxboro Co., Foxboro, Mass. 162B



Centrifugal

Ups capacity for difficult separations.

Super-S-Omatic is a new centrifugal that has a 48 x 30-in. solid basket, and operates at a speed of over 1,500 rpm. According to the manufacturer, this is the first such machine to ever achieve operation at speeds over 1,200 rpm. for a basket of its size. Two such units have already been installed for a major processor of vegetable compounds.

At the touch of a button, Super-S-Omatic automatically starts, feeds, skims, brakes, unloads and recycles. Speed is infinitely variable up to maximum. — Fletcher Works, Inc., Philadelphia, Pa. 163A

Utility Blower

For wide variety of industrial applications.

Fabricated with a heavy-gage steel enclosure, a new utility blower is available with capacities from 650 to 16,000 cfm. The packaged unit comes with an open-type motor that is fully



Shown here are 33 of the 42 tank cars which will be lined in a single month by Lithcote. These cars, however, represent only a part of Lithcote's monthly protective coating application.

HERE'S HOW LITHCOTE CUTS THE HIGH COST OF CORROSION CONTROL

Lithcote Corporation is a corrosion and contamination control *specialist* . . . a pioneer in the manufacture and application of internal and external protective coatings for equipment of all kinds.

Only durable, proved baked-on linings and coatings are applied by Lithcote Corporation—our own time-tested Lithcote line as well as the best of the many other recognized name brands. Furthermore, with our new oven equipment, sprayed Plastisol (PVC) materials may now be applied to *any piece of equipment which can be transported by truck or rail*. Plastisols provide for the resistance of sheet rubber *without seams*, in thicknesses up to 1/8".

Lithcote is also your dependable source for:

AMERCOAT, BISONITE, COLUMBIA #7, COPON, PLASITE, UNICHROME,

PARTIAL LIST OF EQUIPMENT COATED OR LINED BY LITHCOTE

PROCESSING

STORAGE TANKS
TANK CARS
VACUUM TANKS
EDIBLE OIL TANKS
FATTY ACID TANKS
FILTER PRESSES
FRUIT JUICE CONTAINERS
LIQUID SUGAR TANKS

TRAYS
DRYING EQUIP-
MENT
CHEESE VATS
MILK STORAGE TANKS
WHEY TANKS
CARBONATED BEVERAGE EQUIPMENT
WATER TREATING EQUIPMENT

TRANSPORTATION

The many products transported in Lithcote lined tank cars and trucks include:

LATEX
FORMALDEHYDE
ACETALDEHYDE
INVERT SUGAR
EDIBLE OILS
VINEGAR
TALL OIL
CAUSTIC SODA
CARBON
BISULPHIDE
PLASTICIZERS
EMULSIONS
CARBON
TETRACHLORIDE

GLYCERINE
ALCOHOLS
WINES
CORN SYRUP
FATTY ACIDS
TRANSFORMER OIL
ACETIC ANHYDRIDE
SULPHURIC ACID
LARD
LACQUERS
PHENOL
TRIETHANOLAMINE

CHEMICAL AND PHARMACEUTICAL

STORAGE, MEASURING, FERMENTING AND MIXING TANKS
CAST IRON FILTER PRESS PLATES AND FRAMES
VACUUM DRYERS, INCLUDING DRYER PANS
EXHAUST FANS AND DUCT SYSTEMS
PIPE AND FITTINGS
CENTRIFUGES AND CENTRIFUGAL BASKETS
PUMP CASINGS AND OTHER PARTS
AGITATORS AND MIXING EQUIPMENT
TRUCK TANKS
RAILWAY TANK CARS
VALVES
TROUGHS, HOPPERS AND CONVEYORS

PULP AND PAPER

WACO FILTER VATS
AND CYLINDERS
PERFORATED AND SLOTTED SCREEN PLATES
FOURDRINER PARTS
INLET AND OUTLET BOXES

HEAD BOXES
SAVEALL and DECKER VATS
WHITE WATER BOXES
STOCK CANALS
STOCK VALVES
PUMP CASINGS
FEEDWATER TANKS
REGULATOR AND INDICATOR BOXES

PETROLEUM

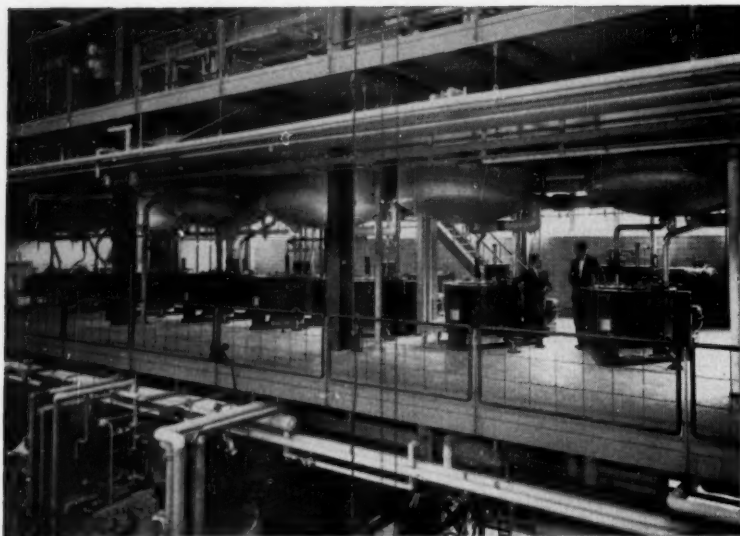
The same Lithcote experience in corrosion control is available to the Petroleum Industry for the internal and external coating of pipe and other equipment.

ASK FOR YOUR LITHCOTE CATALOG



LITHCOTE CORPORATION

5000 W. Lake St., Melrose Park, Ill. • 42 Belden Ave., Norwalk, Conn.
36 W. 44th St., New York 36, N. Y.



Labor savings will pay for these 6 new BATCH-MASTERS® in less than 2 years

Nutley, N. J. — In expanding its production facilities for Gantrisin, one of their sulfa group pharmaceuticals, Hoffmann-LaRoche, Inc., had the option of selecting nine 48" conventional centrifugals or six 48" Tolhurst Batch-Master® machines.

After considering that only one man is required to tend each two "Batch-Masters," while four men are needed for every three conventional units, the manufacturer decided on the former machines. The resulting 75% labor savings will offset the total cost of the new machines in approximately 18 months.

The "Batch-Master's" fast bottom discharge and hydraulic unloading make the difference in labor requirements and in batch processing cycle time.

.....
FOR MORE COMPLETE DATA, SEE
TOLHURST'S SECTION IN CHEMICAL
ENGINEERING CATALOG or write

Tolhurst® CENTRIFUGALS

A DIVISION OF

American Machine and Metals, Inc.

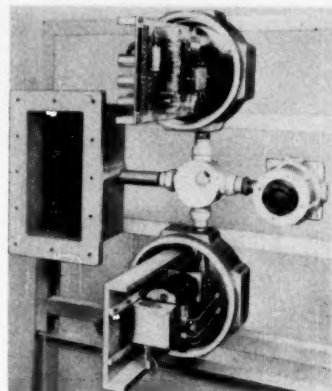
Dept. CET-259, EAST MOLINE, ILLINOIS

SPECIALISTS IN LIQUID-SOLIDS SEPARATION

NEW EQUIPMENT . . .

protected against the elements.

Ball bearings are of the heavy, high-duty, split pillow-block variety. Type J fan-blade sizes range from 12 to 27 in.—
Robinson Ventilating Co., Zelienople, Pa. 163B



Photometric Analyzer

Determines water concentration in liquids, gases.

Precise measurement of water concentration in liquid or gaseous process streams is one possible application for the new Series 500 photometric analyzer. Instrument sensing range covers the span from a few parts per million to percentage magnitudes.

Series 500 measures the ratio of transmission at two different wave lengths. A photoconductor acts as detector, while interference filters isolate selected wave lengths. Available in either standard or explosion-proof construction, the analyzer is supplied with recorder or controller, sample-handling accessories and mounting equipment.—Analytic Systems Co., Pasadena, Calif. 164A

Continuous Blender

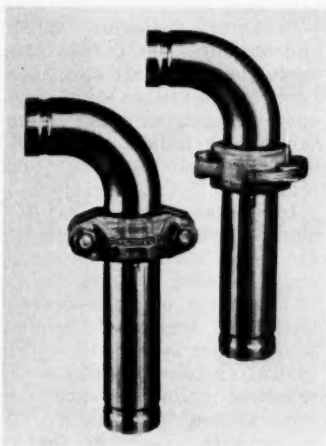
For dry or liquid-dry mixing operations.

Johnson-March Corp. has just introduced a new Verticone continuous-flow blender that accurately proportions, then mixes, blends and discharges a variety of dry materials. The unit also

precisely blends liquids with solids.

Materials to be blended enter the Verticone via volumetric feeding equipment, and fall upon the apex of a cone. The cone evenly distributes the feed into a circular falling curtain of particles. Liquids to be introduced with feed solids spray from both inside and outside of the falling curtain.

Mixing blades complete the operation and automatically discharge the product. In applications where only solids are to be blended, a surface active compound can provide effective and economical dust control by keeping fine particles evenly dispersed to prevent mix segregation. — **The Johnson-March Corp., Philadelphia, Pa. 164B**

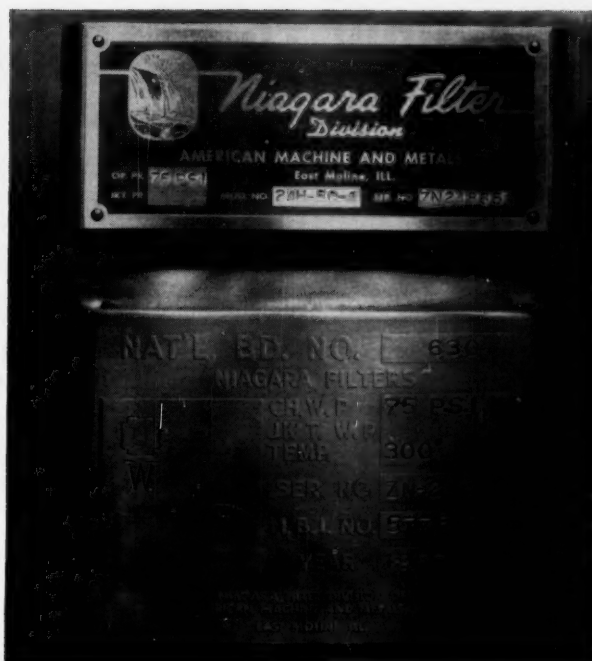


Fittings

Join grooved-end, stainless steel pipe.

According to the manufacturer, a new line of fittings will halve the cost of jointing Schedule 5 and 10 stainless steel piping, compared to welding or flanging methods. The line is the first in a series of new fittings that will permit integrated quick-coupled systems in a wide range of piping materials.

Joints formed by the new fittings are claimed to be leak-tight, capable of withstanding vibration and flexing, and to provide for some expansion and contraction. Stainless steel el-



WITH OR WITHOUT THIS PLATE
all Niagara filters are built in
strict accordance with ASME Code

The same ASME approved material and construction go into every Niagara filter. Welding of all Niagara filters is done by certified welders and all units, whether they are to be code stamped or not, are tested at double the normal operating pressure.

There is no "code equivalent" for ASME Code Standards at Niagara.

The only difference between a Niagara filter with and without the ASME plate is that it must be inspected and stamped by National Board inspectors before the plate is affixed.

The choice of having an ASME plate affixed is yours at nominal extra cost.

See Chemical Engineering Catalog for facts on Niagara Filters, or write us today, outlining your requirements.

Niagara® FILTERS

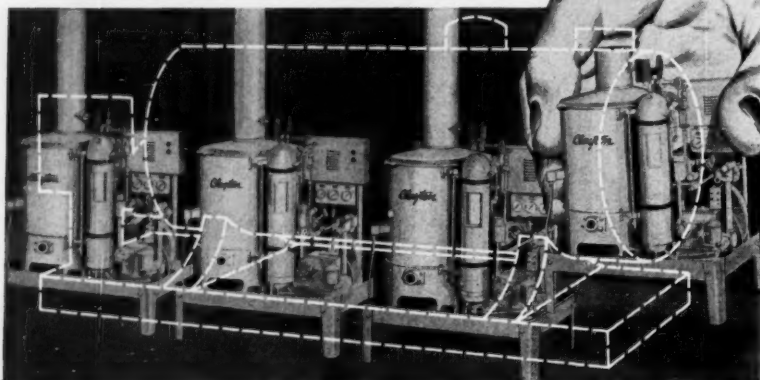
A DIVISION OF
American Machine and Metals, Inc.

Dept. CEN-259, EAST MOLINE, ILLINOIS
(Niagara Filters Europe: Kwakelpad 28, Alkmaar, Holland)

SPECIALISTS IN LIQUID-SOLIDS SEPARATION BY
PRESSURE-LEAF, PLATE and ROTARY VACUUM FILTRATIONS
and CENTRIFUGAL EXTRACTION

HERE'S HOW TO QUADRUPL STEAM PRODUCTION...

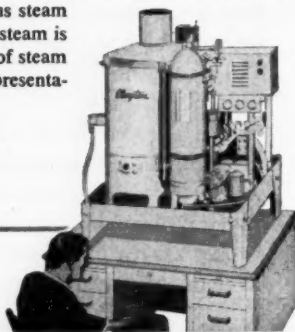
*without expansion
of floor area*



Case history after case history proves that the story is the same. More and more smart business men are specifying Clayton Steam Generators. The reasons are many. Clayton's unique principle of controlled circulation is so efficient that a Clayton requires as little as 25% of the space of an ordinary boiler. Simple to operate too. Just push a button at the start of a shift and in three minutes the unit is at operating pressure. Furthermore, an operating Clayton (full of water) delivers up to 6½ HP per square foot of floor area with as little floor load as 130 pounds per square foot. A Clayton costs less to install...no expensive rigging, stacks or high freight costs.

Compactness is due to Clayton's *controlled circulation* feature which also eliminates drums, headers and other dangerous steam storage vessels. Steam is produced only as steam is demanded...reducing greatly the amount of steam or hot water in storage. Let a Clayton representative give you more facts.

*Where Steam can Serve you
Clayton can Serve you Best*



Clayton STEAM GENERATOR



**READ THE
GUARANTEE THAT COUNTS!**

Compare Clayton's 5-year published coil warranty covering material and labor.

Sirs: Please send us more information on Clayton Steam Generators.

Name _____

Company _____

Address _____

City _____ Zone _____ State _____

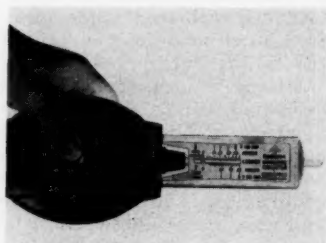
We use steam for _____

Send to: Clayton Manufacturing Company

409 N. Temple City Blvd., El Monte, California

NEW EQUIPMENT . . .

bows, tees, crosses, returns, stub and blank ends, reducers and reducing tees come in sizes ranging from 1½ to 4 in. dia.—Victaulic Co. of America, Elizabeth, N. J. 165A



Indicator

Detects and measures carbon monoxide gas.

Known as the Monoxor, a pocket-size indicator detects and measures the carbon monoxide content of air and gases. Length of a visible stain developed on pumping a gas sample through an indicator tube will measure as low as 0.005% to as high as 0.2% CO.

In operation, a push-button pump draws a 16-cc. sample into the device each time it is actuated. Number of pump strokes is dependent on desired sensitivity and which of the four range scales is to be used. The indicating tube contains a CO-sensitive palladium compound impregnated in silica gel, together with a guard gel that removes gases other than CO.—Bacharach Industrial Instrument Co., Pittsburgh, Pa. 166A

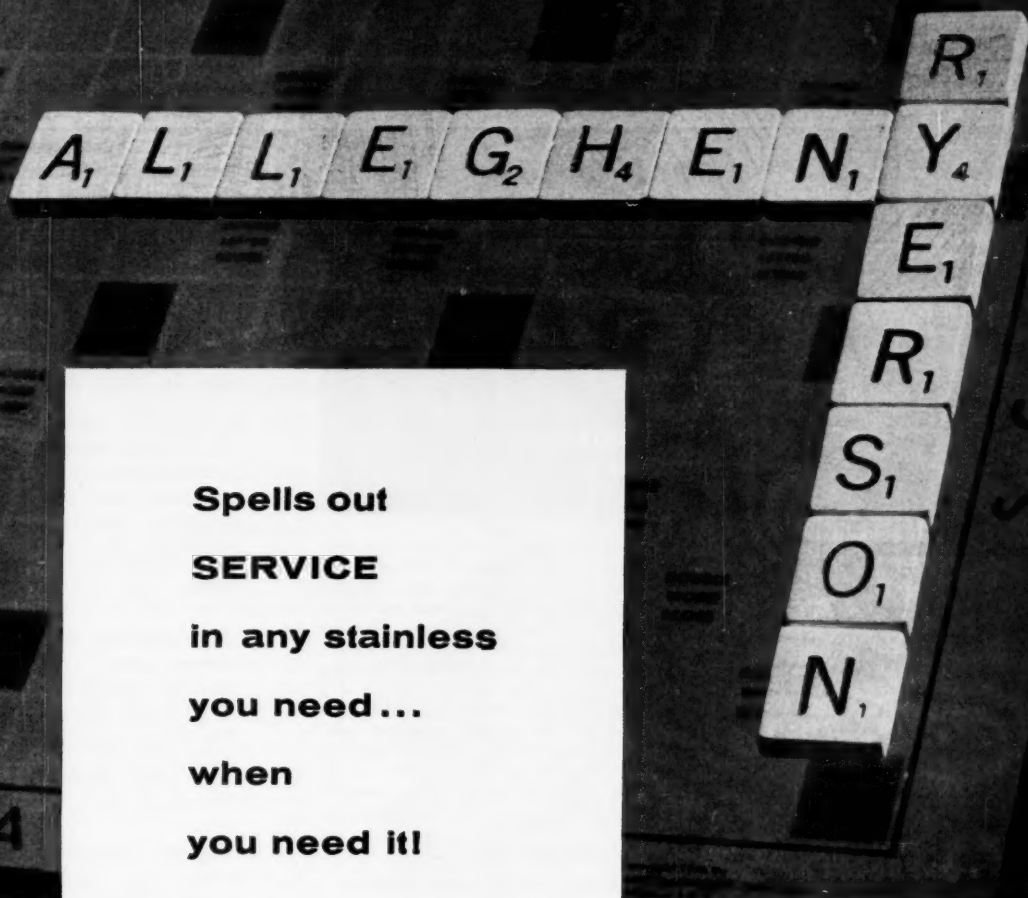
Water Heater

Heat source is injected low-pressure steam.

Field tests on a new steam-injection heater have proved its ability to make hot water for installations having boilers developing pressures of 15 psi. or below. Change of water temperature requires less than 20 sec.

Because unit design eliminates the possibility of pressure equalization between steam and water, "hammer" noises

Experience—the extra alloy in Allegheny Stainless



**Spells out
SERVICE
in any stainless
you need ...
when
you need it!**

You can win only when you buy Allegheny Stainless from Ryerson. Two top names are teamed to give you quality stainless, the fastest way possible!

Allegheny Ludlum is the leading producer of stainless steels in all forms. Ryerson is recognized as the top steel service center. It's a team to bring you the best quality stainless, quick, when you need it.

Ryerson now stocks 2,351 shapes, sizes, finishes and alloys of Allegheny Stainless. It's the most complete line of stainless anywhere! And Ryerson takes the inventory cost from you, gives you as quick service as your own stockroom.

Whether your order is for Allegheny Stainless sheet, plates, bars, or whatever, Ryerson has it in stock. Trained salesmen and technicians to help in selecting or in fabricating are at your beck and call.

For top quality Allegheny Stainless from warehouse stocks, call Ryerson. *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

WSW-7126

ALLEGHENY LUDLUM

for warehouse delivery of Allegheny Stainless, call RYERSON

Export distribution: AIRCO INTERNATIONAL

EVERY FORM OF STAINLESS . . . EVERY HELP IN USING IT



ELLIOTT air magnetic tube expander drives

*automatically controlled
for fast, accurate tube rolling*



**STANDARD
MODEL**

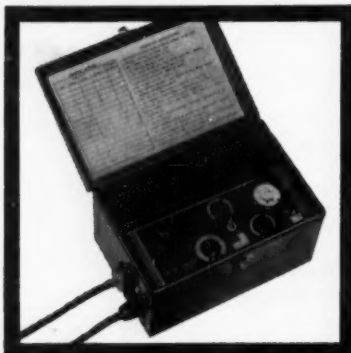


**for HEAVY-
DUTY JOBS**

Designed for faster, precision tube rolling, the standard model Elliott Air-Magnetic drive is setting new records for speed and accuracy. Some operators average 12 tubes per minute. Desired torque easily preset by rotating forward end of unit. No tools needed. Rolling stops when preset torque levels are reached. Includes trigger-controlled, explosion-proof air motor in single unit. Magnetic control, no springs. Balanced for easy handling. For tubes $\frac{1}{4}$ in. through 3 in. *Standard model* handles most jobs. *Heavy-duty* for higher torque.

ALSO Electric Control ... Tube Expanders ...

and Related Accessories



Elliott offers the Automatic Electric Control—an accurate torque-limiting device designed for tube expanding with any standard tapping motor. Also, a complete line of tube expanders, with rotating, parallel, self-feeding rolls. Available in 4 sizes, ranging from $\frac{1}{4}$ in. to $3\frac{1}{2}$ in. O.D.

Other related accessories include Elliott tube gage, tube plugs, tube pilot, and tube rolling lubricant.

Write for descriptive literature today.

Y9-3



ELLIOTT Company

LAGONDA PLANT, Springfield, Ohio

NEW EQUIPMENT...

and damage are prevented. Eight different sizes provide a capacity range of 500 to 30,000 gal./day hot water.—**Pick Mfg. Co., West Bend, Wis.** 166B

BRIEFS

Diesel engine line now offers single, multiple and turbo-powered 2-cycle units ranging in output from 20 to 1,650 hp. Eight new basic machines bring the line's commercial total to 19 models.—**Detroit Diesel Engine Div., General Motors Corp., Detroit, Mich.** 168A

Polypropylene tanks are available in sizes dependent on customer specifications. Claimed to be the first of their kind, the all-welded, self-supporting tanks are recommended for optimum corrosion resistance at high temperatures.—**The American Agile Corp., Bedford, Ohio.** 168B

Data-processing system known as the Univac Computer will rent at \$6,950/mo., and sell at \$347,000. Deliveries of the magnetic - amplifier, solid-state system will begin in June 1959.—**Remington Rand, New York, N. Y.** 168C

Cryogenic container for transport and storage of liquefied gases increases the holding time of contents 30-100% over ordinary vacuum-insulated vessels. Capacity is 25 l.—**Linde Co., New York, N. Y.** 168D

Planimeter enables continuous, accurate integration of regular-size and 3- or 4-in. strip-chart records. Linear accuracy is $\pm\frac{1}{2}\%$; accuracy on square root charts varies from $\pm\frac{1}{2}$ to 1%.—**Royson Engineering, Hatboro, Pa.** 168E

Silicon rectifier for electrical dust precipitators has a far longer service life than types previously manufactured, according to company officials. Selling price will be 29% lower than the manufac-

Now you can get the famous advantages of
ROCKWOOD Ball Valves—IN STAINLESS STEEL—

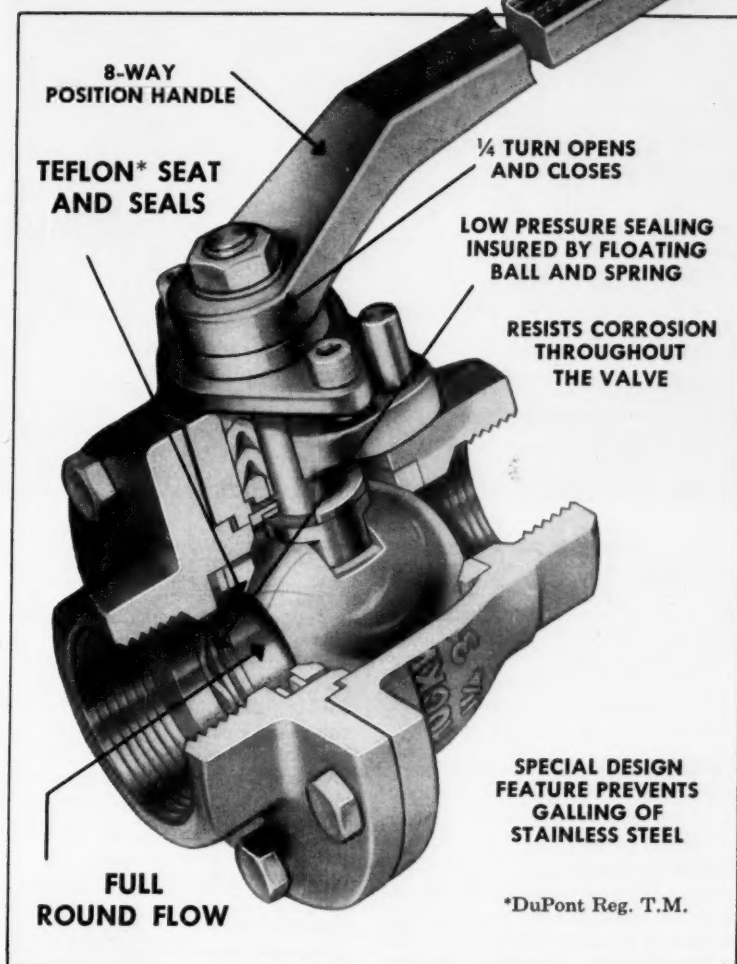
“316”



Rockwood's new "316" Ball Valve gives you positive sealing over a wide range of pressures. A simple design utilizing a Teflon ball seat and spring assures you of low pressure sealing (spring behind ball forces ball against the seat) and high pressure sealing (pressure supplements spring for pressure-tight seal). Friction loss and turbulence are also greatly reduced because of the "316's" straight full round flow passage. Features like these have made Rockwood the most dependable name in Ball Valves.

The new Rockwood "316" comes with various types of seats, remote air-operation of wanted sizes, 3/8" through 2" screwed ends, 3", 4", 6" and 8" flanged ends. 600 W.O.G. minus 100°F to 400°F. And it's just one of a complete line of Rockwood Valves and Unions.

Write for Rockwood's new catalog — the inside story of Rockwood Ball Valves is worth knowing. Tested and listed by Underwriters' Laboratories, Inc. Distributors in all principal industrial areas.



*DuPont Reg. T.M.

ROCKWOOD BALL VALVES



ROCKWOOD SPRINKLER COMPANY
 1068 Harlow Street, Worcester 5, Massachusetts



Send me your new Rockwood Full-Flow Ball Valves Catalog No. 57.

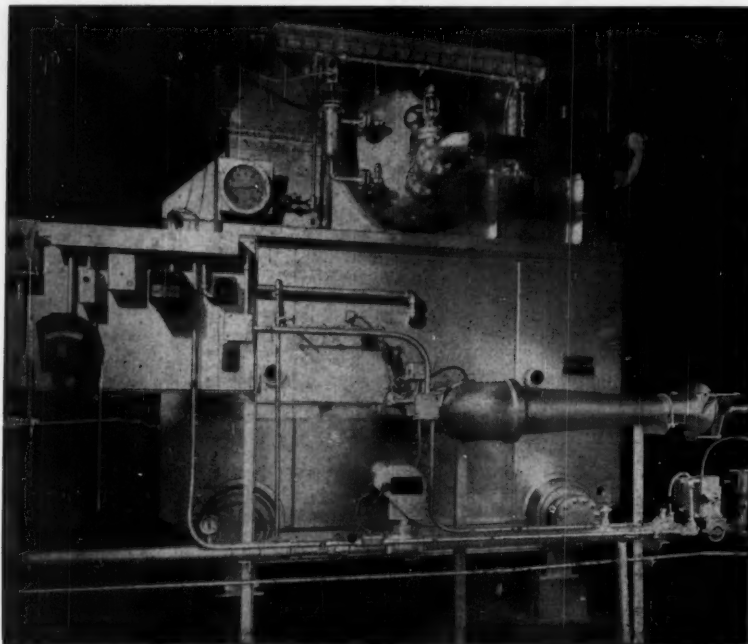
Name..... Title.....

Company.....

City..... Zone... State.....

UNION PACKAGED VAPORIZER

produces closely controlled temperatures
for processing Wesson Oil



Delivering accurately controlled vapor temperatures at low pressures, Union Type MH Vaporizers play an important role in the food and chemical processing industries. The unit shown is used in deodorizing vegetable fats and oils at the South Texas Cotton Oil Co., a subsidiary of Wesson Oil & Snowdrift Co., Inc. Shipped as a package completely shop-assembled, piped and wired with controls mounted, it produces 4 million BTU/hr. at 600°F and 31 psig, and has a rated capacity of 4½ million BTU/hr.

"Very satisfactory" operation is reported by this Wesson Oil subsidiary. Similar MH results have been achieved by numerous other companies in the process industry. Dependable, efficient performance and sensitive temperature control at all times are assured by the

compact, divided tube bank design, straight-through gas flow, and maximum heating surface per BTU.

Both packaged and field erected Union Vaporizers can be outfitted for heating with oil, gas, waste heat or special fuel in outdoor and indoor installations. Union also produces a complete line of Process Heating Equipment for use with Dowtherm "A" and "E", Para-Cymene, Anisole, Aroclor #1248 and Heat Transfer Oil, either convection or forced circulation.

COMPLETE DETAILS

are covered in
Union Bulletin
"DV". Write
for your copy.



IRON WORKS
Erie, Pennsylvania

NEW EQUIPMENT . . .

turer's earlier models.—The Aerotec Corp., Greenwich, Conn. 168F

Spray dryer overcomes the problems of hot spots and charring within the drying chamber by eliminating all piping and hot surfaces on which product can accumulate. A vacuum system continuously removes dried product.—Tower Iron Works, Inc., Providence, R. I. 170A

Subminiature thermocouples, which are as rugged and corrosion-, abrasion- and erosion-resistant as their larger counterparts, are lighter and faster in response. Range of 2-wire unit diameters extends from 0.02 in. to 0.04 in. O.D.—Pyro-Electric, Inc., Barrington, Ill. 170B

Equipment Cost Indexes . . .

	Sept. 1958	Dec. 1958
Industry		
Avg of all.....	230.9	231.3
Process Industries		
Cement mfg.	223.3	223.7
Chemical	232.3	232.7
Clay products	217.0	217.4
Glass mfg.	219.3	219.7
Paint mfg.	222.8	223.1
Paper mfg.	223.8	224.2
Petroleum ind.	227.5	227.8
Rubber ind.	230.3	230.6
Process ind. avg..	228.6	228.8
Related Industries		
Elec. power equip. .	236.0	236.4
Mining, milling	233.7	234.1
Refrigerating	260.3	260.6
Steam power	218.1	218.4

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 125-6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143-4 for annual averages since 1913.

For More Information . . .

about any item in this
department, circle its
code number on the

Reader Service

postcard (p. 185)

Maintenance and Steam Traps

... there's a relationship that goes far beyond trap maintenance alone

Good traps and good trapping have a greater effect on your maintenance costs than does trap maintenance itself. By that we mean that the right traps, properly selected and installed, and with the benefits of a preventive maintenance program, will save far more maintenance dollars than they will cost.

Under the pressure of spiralling maintenance costs, this thought becomes mighty important. Let's take a look at what it involves:

Proper Selection of Steam Traps

1. Be sure it's the right type of trap.
2. Be sure it's sized right and is for the correct operating pressure.
3. Be sure it's first rate in design and construction.

Proper Installation of Steam Traps

1. Install them so they are accessible for inspection and maintenance.
2. Install a test valve.
3. Use a union or unions.
4. Use a shutoff valve or valves.
5. Use a strainer ahead of the trap if dirt conditions are bad.
6. Use a by-pass only where continuity of service is imperative.
7. Standardize inlet and outlet connections.

Preventive Maintenance Program

1. Test trap regularly for proper operation. (Trap size, operating pressure and importance determine frequency.)
2. Inspect internal mechanism at least once a year.

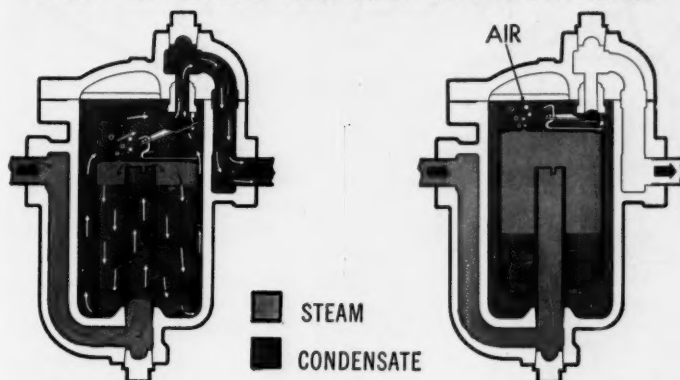
You Get Indirect Benefits As Well

The direct benefits of the plan outlined are pretty obvious — good traps, properly selected, require less maintenance... testing and inspection prevents troubles that lead to maintenance.

However, this plan provides indirect benefits which reduce maintenance in other parts of the plant as well:

Good traps save steam and reduce the load (and consequently maintenance) on fuel handling

HERE'S THE STEAM TRAP DESIGN THAT CAN REDUCE YOUR MAINTENANCE PROBLEMS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

and burning equipment and on ash handling equipment.

Good traps protect the system by eliminating water hammer and preventing the damage it can do.

Good traps discharge carbon dioxide before it can go into solution to form corrosive carbonic acid — less corrosion, less maintenance.

Good traps increase production to reduce the length of time equipment must operate or reduce the amount of equipment needed... either way maintenance is reduced.

How to Go About It (The Sales Pitch)

We admit we're prejudiced, but we don't think there is any better way to select steam traps than with the help of the 44 page Armstrong Steam Trap Book. Here in a single source is specific data on the selection and sizing of traps, how to install them for best results, and how to maintain them most economically.

The Steam Trap Book will also give you full information on the design and construction of Armstrong Inverted Bucket Steam Traps that offer these important maintenance-reducing advantages:

1. Armstrong Traps are dependable.

2. Armstrong Traps require no adjustments — go from full load to zero load automatically.

3. Armstrong Traps are self-scrubbing—ordinary dirt conditions can't hurt them.

4. Armstrong Traps have long-life parts — valve and seat are heat treated chrome steel — lever assembly and bucket are stainless steel.

5. Armstrong Traps have water sealed valves to minimize wire drawing and erosion.

Ask for your copy of the Steam Trap Book—there is no obligation. Then test Armstrong Trapping. If you are not completely satisfied with the results, you can return the traps for a full refund of the purchase price. You can't lose much that way. Call your local Armstrong Representative or Distributor, or write

Armstrong Machine Works
8582 Maple St.
Three Rivers, Michigan

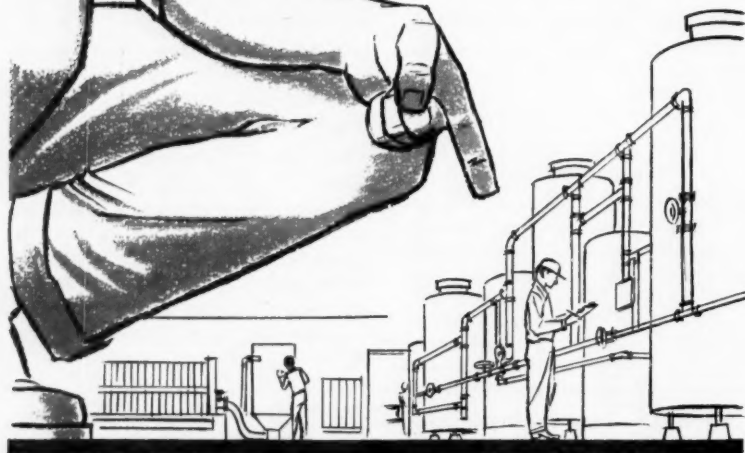
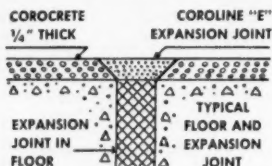


ARMSTRONG
STEAM TRAPS

This
CORROSION-PROOF FLOOR
was pre-engineered
by **CEILCOTE!**



Ceilcote offers 33 years of technical experience in *engineering* floors. Scientifically applied over new or old concrete, **COROCRETE** monolithic floors are four times stronger than concrete . . . offer maximum resistance to acids and alkalis . . . provide for thermal expansion. Available in finishes ranging from non-skid abrasive to highly polished surfaces, **COROCRETE** withstands impact and thermal shock without spalling or cracking. **COROLINE** is used to cover expansion joints or combined with glass cloth reinforcing to line trenches and pump bases. Write today for complete information on materials and installation services.



THE CEILCOTE COMPANY, INC.

4836 Ridge Road • Cleveland 9, Ohio

TECHNICAL

More Gmelin

GMELIN'S HANDBOOK OF INORGANIC CHEMISTRY. Oxygen; System No. 3, 518 pages—\$67.92. Zirconium; System No. 42, 448 pages—\$62.64. Hafnium Supplement Volume; System No. 43, 23 pages—\$4.08. Germanium Supplement Volume; System No. 45, 576 pages—\$79.68. E. H. Pietsch, Chief Editor. Verlag Chemie Publishers, Weinheim, Germany. Available from Walter J. Johnson, Inc., 125 E. 3 St. and Stechert-Hafner, Inc., 31 E. 10 St., New York.

Reviewed by Max Wulfinghoff, consulting engineer, Erlanger, Ky.

Hafnium Supplement Volume—Geochemistry of the element is closely associated with that of zirconium. Volume discusses separation of Hf from Zr compounds and physical, electrochemical and chemical properties of the element. It includes the oxide, nitride, nitrate, tetrafluoride, tetrachloride, chloride, dibromide, tribromide, tetrabromide, boride, borohydride, carbide, carbonate, organic acids, hafnium-bis-ethyl-hydrogen phosphate, strontium hafnate.

Reference literature is complete through 1949.

Germanium Supplement Volume—This covers research work published between 1931 and 1953. As a transition element with both metallic and nonmetallic properties, germanium forms homopolar compounds.

As a homolog of carbon, it has the ability to form organic compounds with Ge-C bonds, having partly chain and partly ring-form structures. More than 200 compounds of this type are tabulated with their properties and methods of preparation. Following topics include the recovery of high-purity Ge by physical methods and zone melting, radioactive tracer method for controlling process efficiency, qualitative and quantitative analysis of

BOOKSHELF

J. B. BACON

Ge. Germanium compounds and alloys take up 100 pages.

The physics of germanium, on 414 pages, deals with the atomic nucleus, the atom, and crystallographic, thermal, and mechanical properties; semiconductor phenomena, applications of semiconductor diodes, transistors, photo-transistors. Electrical properties cover 255 pages.

Data on electrical, optical and photo-electric properties are complete through 1954; review of recent progress, through 1955.

This is probably the most advanced text on the physics of germanium presently available.

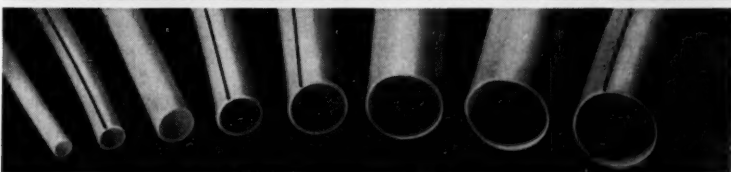
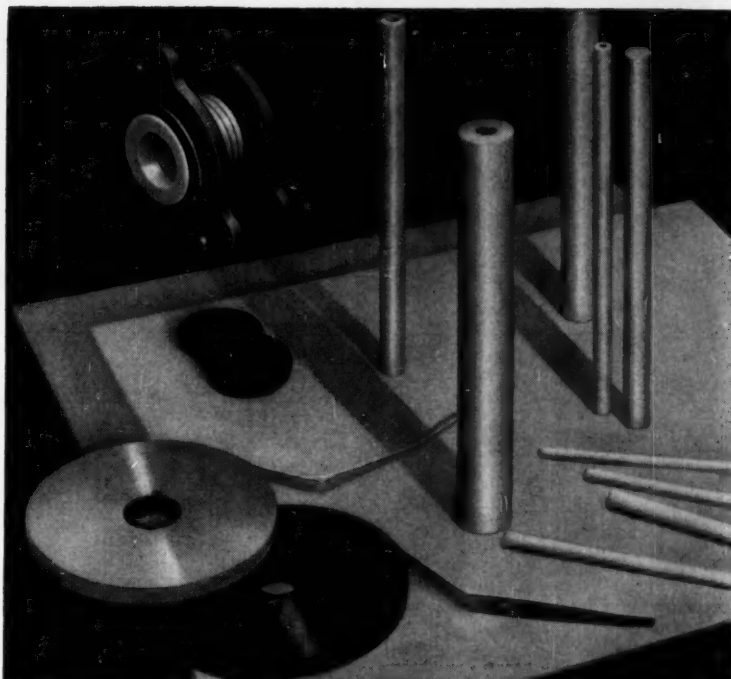
Oxygen—The first 17 pages review the recovery of the element, and the separation and enrichment of the isotopes. The physical properties of oxygen take 275 pages, dealing with the atomic nucleus, atomic radius and ionic radii, and the oxygen atom and ion as standards in calculations. Then follow paragraphs on molecular and physical properties.

Forty pages are devoted to the solubility and sorption of oxygen. Fifty-three pages cover the optical properties, band systems, magnetic properties, electrical properties, the Joshi effect, electron affinities of atom and molecule. Next are electrochemical reactions of atmospheric air and elemental oxygen, standard potentials, cells, overvoltage phenomena, the oxy-hydrogen electrode and the oxy-hydrogen coulometer. Reactions in oxygen-hydrogen and in hydrogen-air mixtures (195 pages) include photo-chemical, surface and thermal phenomena and many others.

Coverage of reference literature is complete through 1949.

Zirconium—Brief historical review starts with Klaproth's discovery of Zr in a Ceylon zircon in 1789.

Along with the physical properties of the element and its compounds, alloys with metals of lower system numbers are treated in detail. Applications in industry include the vacuum



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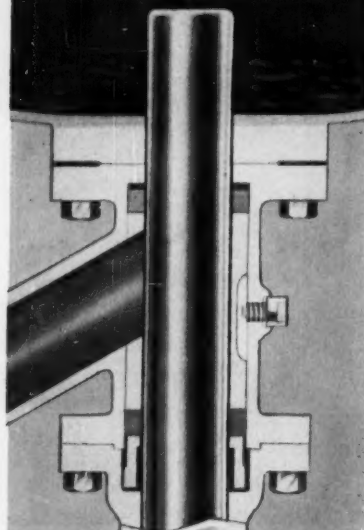
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and electrical engineering fields (lighting and electronics), use as getters and alloy constituents, in refractories, and in catalysts. The iodide and Kroll methods of recovery are discussed, and the production of wires, coatings, powders, and colloidal Zr.

Data are given on chemical reactions of the element with metals and non-metals, salts, acids and bases, with air, oxygen, hydrogen, nitrogen—and of Zr salts with Hf salts, in view of the analytical significance of the latter.

Reference literature has been covered fully through 1949. The subject index is bilingual.

A Broadened Base

SURFACE CHEMISTRY — THEORY AND APPLICATIONS, 2nd ed. By J. J. Bikerman. Academic Press, New York. 501 pages. \$15.

Reviewed by F. C. Nachod, Sterling-Winthrop Research Institute, Rensselaer, N. Y.

Now, after ten years, a revised and enlarged edition of Dr. Bikerman's text originally subtitled "for industrial research" is available. Some topics which are not surface effects (e.g., ion exchange) have been eliminated, while others (e.g., electric double layers) have been added.

The author hopes to capture a wider audience by broadening the base of the text without decreasing the usefulness to the industrial investigator. In this, according to this reviewer, he has succeeded very well.

At the same time new references have been introduced and the literature appears to have been covered up until 1956. The text can be recommended to all who are investigating or studying surface phenomena.

MORE NEW BOOKS

ELASTICITY, PLASTICITY AND STRUCTURE OF MATTER. By R. Houwink. Dover Publications. \$2.45.

ORGANIC SYNTHESIS WITH ISOTOPES, Part 2. By Arthur Murray, III and D. Lloyd Williams. Interscience. \$25.

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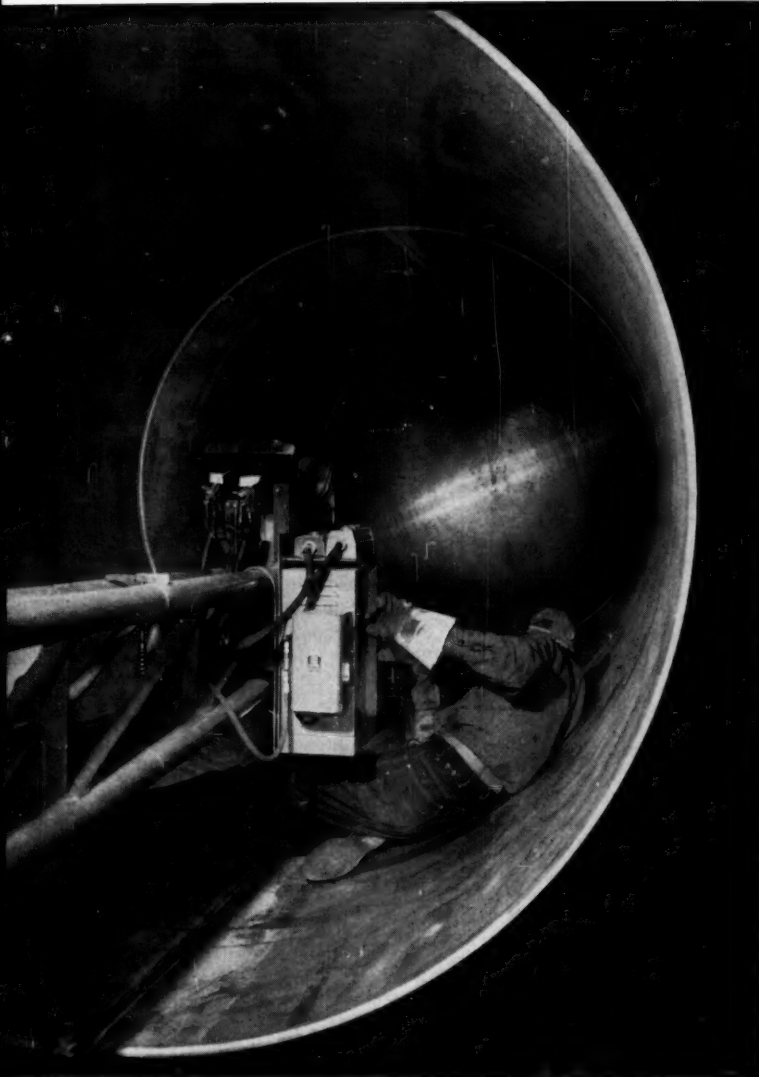
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BULLETIN G-579 — Describes the DAY Type "R" filter. An all purpose, versatile unit. Bulletin gives operating features, dimensions and specifications.

BULLETIN 573 — Dual-Clone dust separators — noted for their low resistance and high cleaning efficiency. Easy to install, no maintenance, no moving parts.

BULLETIN 576 — "HV" heavy duty dust separator. Rugged construction and lower initial cost than many light gauge galvanized type cyclones.

BULLETIN F-75 — Reverse Jet Dust Filter Facts. Complete with specifications, typical equipment layouts, capacity and performance tables for DAY type "AC" filter.

BULLETIN H-578 — Gives complete information about Style "A" rotary valves. Construction features, specifications, dimensions and applications.

"SCHLITZ DEFEATS DUST" — FOOD ENGINEERING magazine reprint describes all out dust control for 3½ million bushel Schlitz grain elevator. Request Bulletin "Schlitz Defeats Dust."

"EFFICIENT DUST SNATCHERS" — Bulletin describes DAY's part in providing maximum safety and good housekeeping for large food processor.

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LETTERS:

Polyethylene Clarified

Sir:

I refer to your most interesting article, "What's Happening to Linear Polyethylene?" (Sept. 22, pp. 86-90) and wish to call to your attention some inaccuracies derived from the fact that the Harvard Report (which the article reviews) was designed more for business men than a technical readership.

Said report has a tendency to consider linear polyethylene as one of the new stereospecific polymers. In truth, there is a substantial difference between linear polyethylene and the sterically differentiated polymers of monomers having three or more carbon atoms, discovered by Prof. Natta.

Your footnote on p. 86 (first column) implies that the term "isotactic polyethylene" is synonymous with "low pressure," "high density," "ordered," "crystalline."

Actually, there is no such thing as "isotactic polyethylene," and the various words have quite different meanings. The term "isotactic" was coined by Prof. Natta to indicate one general type of sterically ordered polymer having a structure characterized by regularity of the succession and the position of side branches. Such side branches either do not exist in linear polyethylene or represent only an occasional exception.

Here are some additions and corrections to the minutes recorded in the "polyolefin timetable" (p. 90):

1943: It was the Max Fischer group of I. G. Farben which first used organometallic catalysts.

1947: C. E. Schildknecht and coworkers at General Aniline & Film worked with vinyl isobutyl ether to arrive at the first known case of what was later recognized as a stereospecific polymer. But vinyl isobutyl ether is *not* an olefin.

1954: Giulio Natta first announced his discoveries of sterically differentiated polypropylene and stereospecific propylene

PRO & CON

C. H. CHILTON

polymerization processes, coining the words isotactic, syndiotactic and atactic.

1957: In September Montecatini, exclusive owner of the patents and patent applications on Prof. Natta's findings, was on stream with the world's first commercial polypropylene plant in Ferrara, Italy. It had been in pilot-plant production at that same location for several years.

1958: By January Montecatini was bringing commercial quantities of polypropylene to this country.

It may also interest your readers to know that Montecatini is working with isotactic polystyrene as well as various copolymers of ethylene and propylene.

MARIO L. OTTOLENGHI
Chemore Corp.
New York, N. Y.

Pro: Clear Exemptions

Sir:

Text of the article, "Should Your Employer Pay You Overtime?" (Dec. 1, pp. 127-128) was rather confusing to me. This was one of the worst articles I have read in your magazine, and a word of clarity from you would be greatly appreciated.

In the main text, the author gives salary minimums for the three classifications, and then in a quick reference section he lists different minimums. Also, he defines an executive chemical engineer as being exempt if he devotes more than 20% of his time to nonexempt work. This doesn't make sense.

N. DEAN HUPP
Wyandotte Chemicals Corp.
Wyandotte, Mich.

► There was a typographical error in our definition of an executive chemical engineer. The wording should have read: "Who devotes no more than 20% of his workweek to nonexempt work," similar to the wording used to define administrative and professional chemical engineers.

Why the different salary minimums? In effect, the Dept. of Labor

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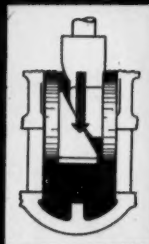
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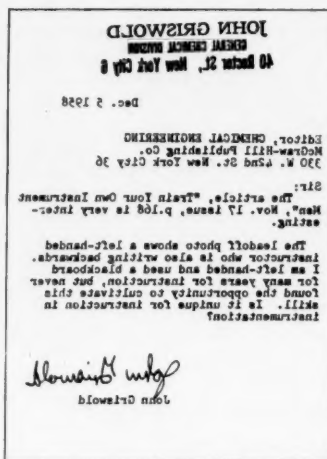
Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



PRO & CON . . .

investigators use the short tests to save themselves time. If an engineer earns less than the lower figure, he is automatically non-exempt; if he earns more than the higher figure, the investigator would not have to apply the detailed regulations as to percentage of time spent in nonexecutive, non-administrative or nonprofessional duties.

See Jan. 26 issue for a report on the new schedule of salary minimums which went into effect on Feb. 2.—ED.



Con: Writing Backwards

Sir:

The article, "Train Your Own Instrument Men," Nov. 17 issue, p. 168, is very interesting.

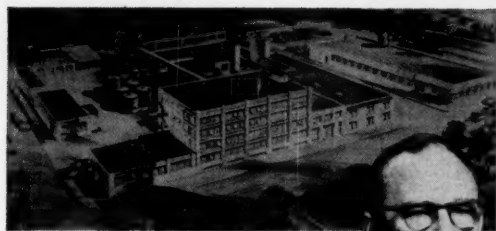
The leadoff photo shows a left-handed instructor who is also writing backwards. I am left-handed and used a blackboard for many years for instruction, but never found the opportunity to cultivate this skill. Is it unique for instruction in instrumentation?

JOHN GRISWOLD

General Chemical Div.
Allied Chemical Corp.
New York, N. Y.

► Our engraver does what he's told. When we instruct him to "flop left to right," he simply reverses the film negative used at the intermediate stage in the photoengraving process. Art editors sometimes insist that engravings be flopped in order to achieve a more attractive page layout.

Just to show Dr. Griswold how easy it is to write backwards, we have made a reverse engraving of his original letter.—ED.



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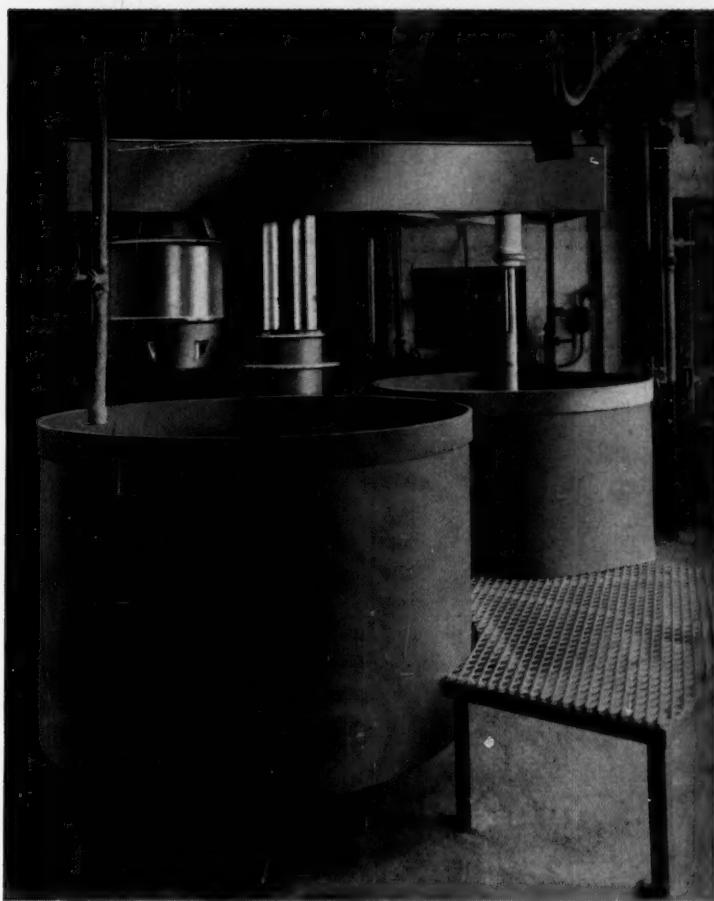
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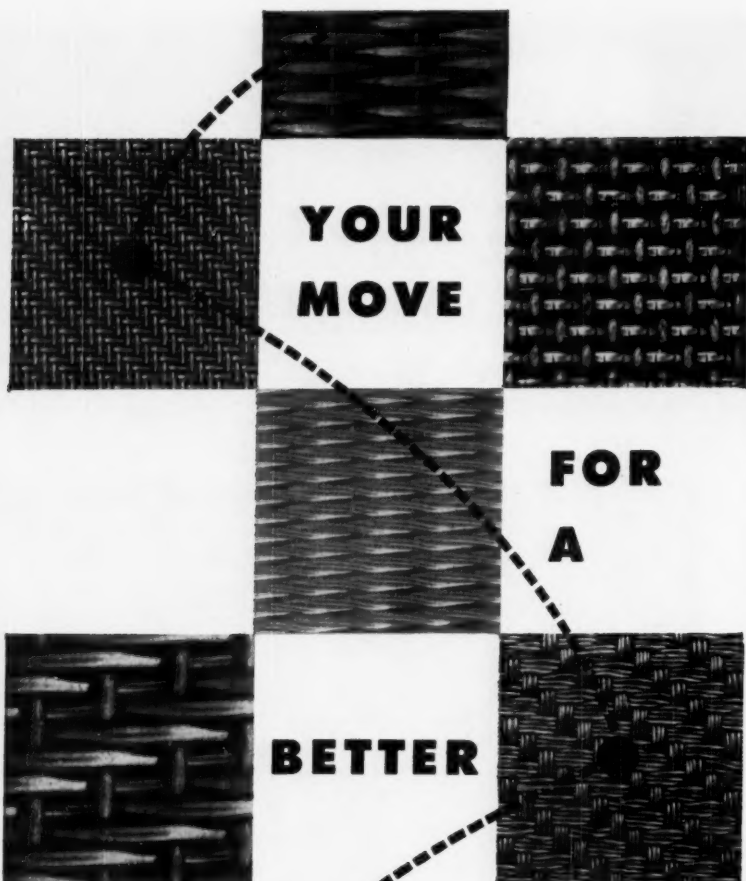
CHEMICAL ENGINEERING—February 9, 1959



A Cowles Dissolver at work in one of two 500 gal. tanks used for pre-mix prior to milling at Seidlitz plant. When batch is finished, Cowles will swing to second tank.

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Dear Readers:

I'd like to introduce to you *CE's* latest staff addition: Bill Schall, Kansas-born, Iowa-bred, Carnegie Tech-educated chemical engineer.

Many of you will be meeting Bill and working with him on article ideas. His major activities will be in the area of process instrumentation and computers. These are "naturals" for him, since he already has personal interest, knowledge and contacts in these fields—gained, largely, from his experiences in technical editing with the Instrument Society of America during 1955 and 1956 and, in recent months, with McGraw-Hill's *Control Engineering*.

But Bill has other interests, too. One of these is cost estimation. So it's only natural for him to take over the care and feeding of the *CE* Cost File, our newest editorial department.

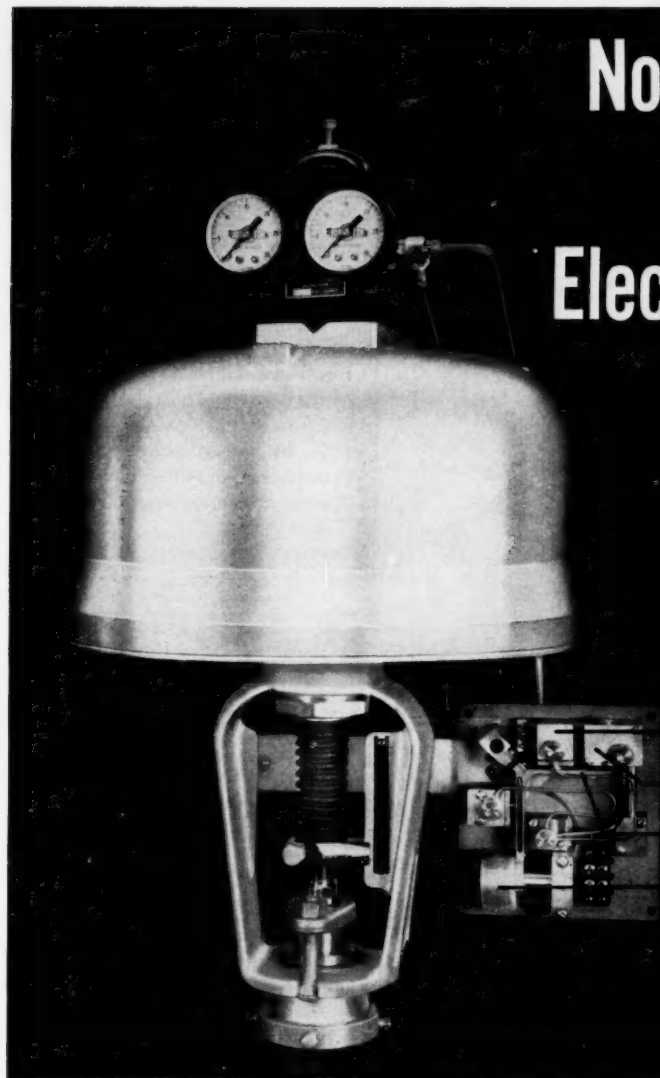
In college, Bill went in heavily for editorial work on the *Carnegie Technical*; there he did feature writing for four years, served as managing editor and chief editor. In 1956 he won first prize in a competition sponsored by the Pittsburgh section of AIChE for his report on experimental work in unit operations. In 1956 he also won the Carnegie Tech Essay Contest, and in 1957 he placed second.

Despite Bill's serious interest in chemical engineering as a profession, his fascination with music and the stage once came close to nipping his engineering career in the bud. After he had spent an abortive four quarters at Iowa State College in musical comedy production—with almost total neglect of his engineering courses—the Army grabbed Bill and sent him to OCS.

Two years later, and sobered, Lt. Schall married Paula Brown, high school friend and Wellesley graduate, then went to Carnegie to pursue his career in chemical engineering. He's still true to both loves.

JOHN R. CALLAHAM
Editor-in-Chief
Chemical Engineering

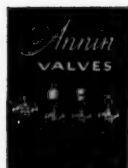
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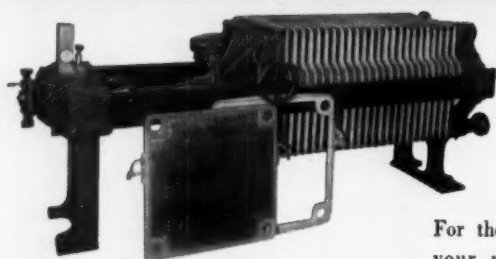
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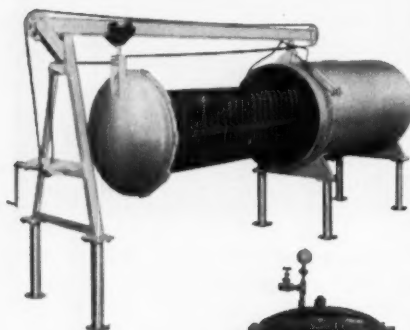
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TECHNICAL

Contents of This Issue

Chemicals & materials..	182
Construction materials..	188
Electrical & Mechanical equipment	189
Handling & Packaging..	190
Heating & Cooling.....	190
Instruments & Controls..	191
Mechanical equipment..	189
Pipe, fittings, valves....	191
Process equipment	193
Pumps, blowers, compressors	197
Services & processes....	198

Chemicals

Acids & Anhydrides..... Company's data on organic acids and anhydrides, formerly in two booklets, have been collected in new 44 p. "Acids & Anhydrides."
182A Union Carbide Chemicals Co.

Adhesives..... Bi-monthly, "Narmco Engineering Topics," is available to engineers & designers using sandwich construction, adhesive bonding, structural plastics.
182B Narmco Resins & Coating Co.

Alloys..... 40 p. guide to the corrosion resistance of Haynes alloys contains charts & graphs showing penetration rates for alloys in over 250 corrosives.
182C Haynes Stellite Co.

Bromine Compounds, Organic..... 4 p. Bulletin 50-B contains a list of 28 chemicals and prices of them in 10-, 25-, 100, and 500-gm. quantities.
182D Beacon Chemical Industries

Calcium Carbonates..... "Witcarbs in Paint" describes savings obtained by substituting an extremely white chemically precipitated calcium carbonate for prime white.
182E Witco Chemical Co.

Carbon Black..... 37 p. "The Dispersion of Carbon Black in Rubber & its Role in Vulcanizate Properties," discusses studies made at Columbian Carbon Co.
182F Phillips Electronics, Inc.

Carbon Dioxide..... CO₂ comes in a variety of forms & quantities ranging from 50-lb. cylinders & dry ice to 24- & 30-ton tank cars for unloading to your process.
155 *Olin Mathieson Chem. Corp.

Chemicals..... A new General Products list has 12 pages of quick references to all chemicals & services. Other bulletins are also available. Bul. 100-B.
159a *Hooker Chemical Corp.

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Coatings, Polyester..... 3 p. Alkydol Reporter No. 9 tilted "Alkydol S-1718" describes polyester type coating resin, formula suggestions, evaluation of enamel products.
183A Alkydol Laboratories, Inc.

Dyes..... 4 p. brochure on carrier dyeing tells how to use company's Emkalars DA, 29 and MN on Du Pont's polyester fiber, Dacron, and Celanese's triacetate, Arnel.
183B Emkay Chemical Co.

Fluorine..... Information on Fluorine is contained in technical bulletins, "Fluorine," or "Handling Elemental Fluorine in the Lab."
61

*Allied Chemical, General Chem. Div

Herbicides..... Illustrated brochure describes various application of a selective pre-emergence herbicide, Eptam. Outlines crops and weeds for which it can be used.
183C Stauffer Chemical Co.

Metal Hydrides..... "The Mixed Hydrides," a 28 p. review of selective reductions of organics with metal hydride systems was written by M. N. Rerick, Univ. of Notre Dame.
183D Metal Hydrides Inc.

Mineral Fillers..... A basic study of characteristics and applications of Dicalite diatomite mineral fillers is provided in Dicalite Technical Bulletin E41.
183E Great Lakes Carbon Corp.

Oxygen Storage Unit..... A Driox oxygen storage unit provides a continuous flow of liquid oxygen, or converts it automatically to gas. Constant pressure maintained.
131 *Linde Co., Div. Union Carbide

Phenolics..... 6 p. pamphlet, No. D 203, describes new Durex 16441 Natural, a high impact phenolic molding compound reinforced with Fiberglas.
183F Hooker Chemical Corp.

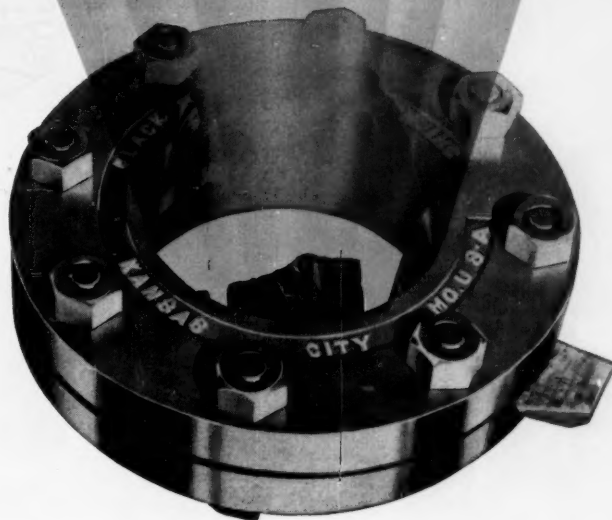
Plastic..... Full information Teflon expansion joints, tubes, thin-wall tubing, rods, sheets, tape bondable Teflon & parts is contained in detailed literature.
173 *Raybestos-Manhattan, Inc.

* From advertisement, this issue

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Pictured above is what happens when a pressure vessel protected by a BS&B Safety Head develops pressures above safe limits. "Heart" of the Safety Head is the rupture disc, which bursts to relieve the overpressure instantly and completely—guarding against injuries to personnel and damage to plant equipment.

BS&B Safety Heads protect pressure systems in every type industry

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BS&B Rupture Disc — "Heart" of the Safety Head

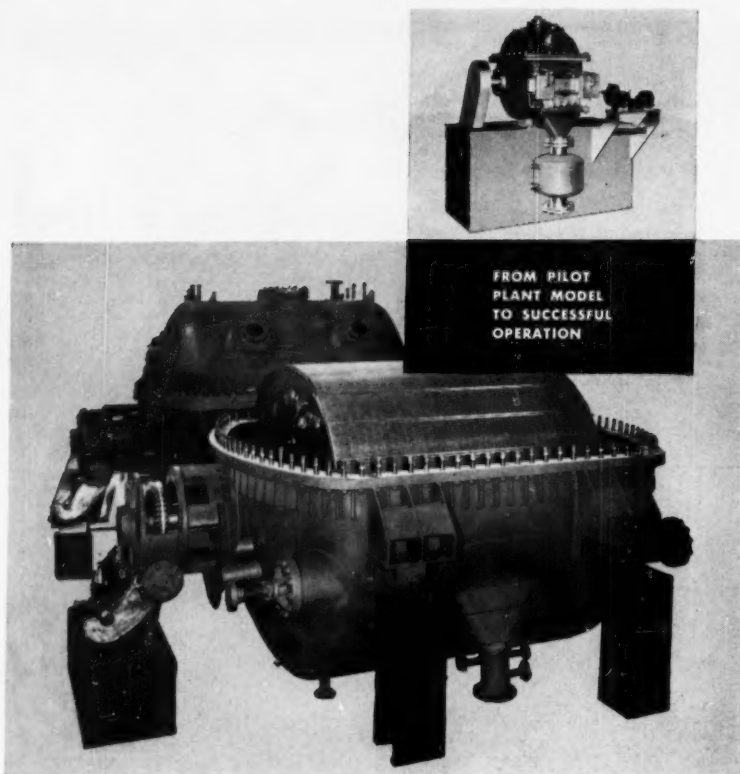
BS&B rupture discs are designed to relieve pressures at any specified point from 3 to 100,000 pounds per square inch. They are available in standard sizes ranging from 1/4 inch to 36 inches in diameter, and in special sizes and types for virtually any application.

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106 *Joseph T. Ryerson & Son, Inc.

Potassium Carbonate.....ideal for removing carbon dioxide under conditions of fairly high concentration & partial pressure from process gases. Details available.
83 Allied Chem., Solvay Process Div.

Radioisotopes.....4 p. Technical Bulletin 3 describes use of radioactivity in helping measure the amount of a substance in a mixture where usual analysis won't work.
184A Nuclear-Chicago Corp.

Reagents.....336 p. catalog describes about 6,500 organic and inorganic chemicals, solutions for analytical use, indicators, microscopical stains, resins, dyes.
184B British Drug Houses

Reagents.....36 p. book contains an alphabetical listing of the various reagent chemicals, indicators, stains and culture media, and solutions. Catalog R-59.
184C Central Scientific Co.

Resins.....TFE resins give you exceptional latitude in designing all types of sealing devices. Can be used up to 500 F. & offer low coefficient of friction. Tech. Data.
87 *E. I. du Pont de Nemours & Co.

Resins & Plastics.....12 p. "Chemical, Resins, Plastics" discusses thermosetting and thermoplastic industrial resins plus other chemicals, e.g., antioxidants.
184D Catalin Corp. of America

Silicones....Leaflet on "How Silicones Reduce Insulator Flashovers" describes curtailment of arcs & shorts, & formation of leakage paths on insulators in contaminated air.
184E Dow Corning Corp.

Silver Brazing Alloys.....New paste alloys are described in a 1 p. engineering data sheet No 88-1. Pastes described cover most applications in the field.
184F Fusion Engineering

Surfactants.....100 p. "Emulsions & Detergents" gives fundamentals of surfactants & emulsion formulation, specific formulas for use in textile & other industries.
184G Union Carbide Chemicals Co.

Tantalum.....4 p. technical folder describes the application of high-purity tantalum to the electronic, nuclear, chemical and missile industries.
184H National Research Corp.

Vinyls.....20 p. Bulletin G-17 covers rigid polyvinyl chloride compounds. Tables in the bulletin give physical constants and considerable performance data.
184I B. F. Goodrich Chemical Co.

Vinyls.....26 p. "Insular Vinyl Polymers & Copolymers" contains technical specification sheets and application recommendations, tests methods.
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4d	22	42	75	87	105	154	163	168F	178	183F	190A	193A	196E	199C
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Aluminum Conduit offers many special features such as light weight, ease in handling, corrosion resistance, less voltage drop and clean modern appearance. Booklet. 22 *Aluminum Company of America

Castings alloyed to fit each specific requirement & finished to any extent desired. Melt, castings & finishing are carefully controlled. Bul. 3150-G. 190 *The Duraloy Company

Coatings Sprayed ceramic surfaces are highly resistant to abrasion erosion and fretting corrosion under even the most difficult slurry service. Bulletin CP28.

L192 *Chemical & Power Products, Inc.

Fabrication Brochure "Working With Metal" gives factual information on designing, engineering and specialized fabrication in chemical processing. 197 *The Boardman Co.

Floor, Corrosion-Proof Corocrete monolithic floors offer maximum resistance to acids & alkalis . . . provide for thermal expansion. Information available on request. 172 *The Celcote Co., Inc.

Insulation, Metal-On consists of Thermobestos calcium silicate insulation, a vapor barrier & an all weather protective covering of aluminum. Brochure IN-217A. 12-13 *Johns-Manville

Linings & Coatings Catalog outlines the line of internal & external protective coatings & linings for equipment of all kinds. Contamination & control specialists. 163 *Lithcote Corporation

Metal Pall Rings available in the 1/2", 1", 1 1/2" & 2" sizes from carbon steel, the 18-8 series of stainless steels, monel, inconel, titanium, aluminum & copper. Details. 54 *U. S. Stoneware

Insulation Pipe Brochure describes Snap-On pipe insulation, a composition of blown-glass fibers bonded together with phenolic resin. Snaps into place on piping. 188A *Gustin-Bacon Mfg. Co.

Refractory Brick New booklet covers application, characteristics, chemical analyses. Also includes helpful data on materials of construction for temp. up to 4,400°F. 33 *Norton Co., Refractories Div.

Rubber & Plastics Chemical resistant equipment such as plastic pipe pachydermous pail, linings, fittings, valves, etc. Bulletins 80A & CE-53 give details. 152 *American Hard Rubber Co.

Tile, Acid-Proof Duro tile are dense & non-absorbent throughout their entire thickness. A descriptive bulletin gives all the facts & specifications.

133 *Harbison-Walker Refractories Co.

Wire Cloth A 94-page catalog & stock list gives the full range of wire cloth available, describes fabrication facilities & gives useful metallurgical data. 81 *Cambridge Wire Cloth Co.

* From advertisement, this issue

Electrical & Mechanical

Conduit Fittings.....Solid Aluminum

Electrolets has resistance to corrosion. Gives extra strength at points of stress. Catalog of electrical fittings & fixtures offered.

23 *Killark Electric Mfg. Co.

Drives.....Air magnetic tube expander drives and also electric control tube expanders and related accessories are covered in descriptive literature.

168 *Elliott Co.

Electro-Pneumatic Actuators.....The Model 30,000 features full-scale zero adjustment & a wide range of span settings for split range sequencing applications. Cat. 1500-D.

181 *The Annin Company

Lighting Fixtures....."AA-51" series vented explosion-proof lighting fixtures feature a new anti-vibration guard which protects against spark caused mishaps. Details.

56 *Appleton Electric Co.

Motor, Motorbrake.....available in polyphase, as well as single phase & d-c. Equally good for vertical & horizontal mounting. Built for horsepower ratings $\frac{1}{2}$ to 150.

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Motors.....Type DP motors feature rugged cast iron frames & endplates which are highly resistant to corrosion. Complete information in Bulletin MU-233.

141 *Wagner Electric Corp.

Motors.....Life-Line "A" motors feature fool-proof sealing against corrosion, long life and low maintenance. Complete facts about these motors available on request.

10-11 *Westinghouse Electric Corp.

Rectifier Equipment.....Balancing Reactors force even distribution of the load among all rectifying elements, regardless of individual cell characteristics. Guide.

B207 *Sel-Rex Corporation

Rings.....C-V Rings for low pressure service & high pressure service are available in full line of standard sizes & male & female adaptors. Details in Bul. P-325.

154 *Crane Packing Co.

Steam Turbines.....built to customers' specifications, including API and NEMA standards. Further facts on turbines contained in new Catalog 200. Available now.

21 Coppus Engineering Corp.

Speed Reducer & Control.....Booklet on Stepless Variable Speed contains typical applications, dimension, specifications, installation suggestions & ordering information.

189A Revco Incorporated

Thermocouples.....Spring-loaded thermocouples assure dependable contact. All probes & adapters are of stainless steel. Available in C-C, 1-C and C-A. Bulletin 2E.

BL209 *Thermo Electric Co.

Turbines.....YR turbines are designed for easy installation & service. Many key parts are interchangeable for various frame sizes. Descriptive bulletin H22-C is offered.

143 *Elliott Company

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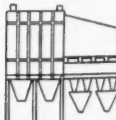
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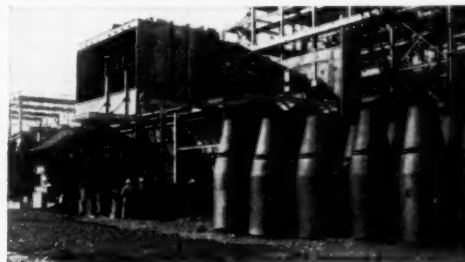
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SF ELECTRIC PRECIPITATORS



PRECIPITATOR-CYCLONE COMBINATIONS

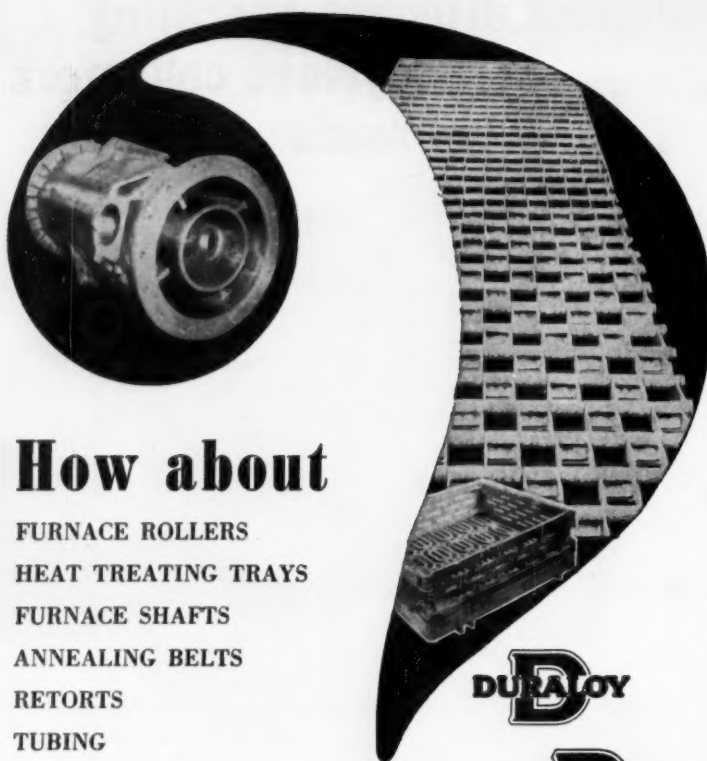


Buell Cyclones before installation at a major plant.

buell

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS



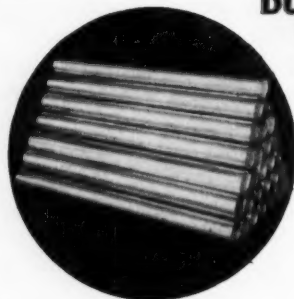
How about

FURNACE ROLLERS
HEAT TREATING TRAYS
FURNACE SHAFTS
ANNEALING BELTS
RETORTS
TUBING

Which are
Heat Resistant

Corrosion Resistant

Abrasion Resistant



When ready to order, how about checking with us here at DURALOY? For more than thirty years we have specialized in high-alloy castings. In fact, we were among the first to produce static castings and the first to produce centrifugal castings. We are old hands at producing castings alloyed to fit each specific requirement and to finish them to any extent desired.

Melt, castings and finishing are carefully controlled and quality tested by our staff of metallurgists, chemists, X-ray and gamma-ray technicians. If you would like more preliminary information, send for Bulletin No. 3150-G.



DURALOY Company
OFFICE AND PLANT: Scottdale, Pa.

EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
ATLANTA OFFICE: 76—4th Street, N.W.
CHICAGO OFFICE: 332 South Michigan Avenue
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.

LITERATURE . . .

Handling & Packaging

Conveyor, Air Gravity. . . . Air-Float for moving dry, pulverulent materials horizontally. Literature describing this & the complete pneumatic conveying systems offered.

R174 *Kennedy Van Saun

Conveyor, Airstream. . . . can be teamed up with all types of portable containers. Details in a new 12-page report "New Techniques for Automatic Bulk Handling".

50 *Dracco Div. of Fuller Co.

Conveyor Components. . . . Facts on the complete line of accessories are contained in Folder 2489. They can be installed on new or existing systems.

4a *Link-Belt

Fork Lift Trucks. . . . Detailed information on a new method of power application for fork lift trucks—based on hydrostatic principles—is available in new booklet.

190A Towmotor Corp.

Materials Handling. . . . Complete data on the new model H-25 Payloader available. Handles more material per hour at less cost per ton. Carry capacity of 2,500 lbs.

34 *The Frank G. Hough Co.

Materials Handling System. . . . Catalog #7 describes the Tote system of materials handling. Cites examples of how system saves labor, cuts costs, saves warehouse space.

190B Tote System Inc.

Plastic Liners. . . . Booklet offers helpful information on liners for containers, bags for products & materials and specialties for custom packaging, machinery, etc.

190C Protective Lining Corp.

Platform Stacker. . . . Model WLT platform stacker creates greater maneuverability for skid and skid box operations in congested areas. Bulletin 1016-W describes fully.

190D Automatic Transportation

Tanks. . . . Glasteel Chemstor tanks are ideal for products that tend to cling. They protect against corrosion & contamination & feature high strength. Details in Bul. 918.

212 *Pfaudler Permutit, Inc.

Weighing System. . . . The new Bul. 582 describes in detail the Way-Pac line of low-capacity, low-price packaged systems for tank weighing & figuring costs.

75 *A. H. Emery Co.

Heating & Cooling

Heat Exchangers. . . . Readily assembled to handle any combination of liquid & gases. Can be used as a heater, cooler, condenser or vaporizer. Bulletin 302.5K1.

41 *American Standard

Heat Transfer Equipment. . . . Plate-coil available in styles, sizes and metals to fit the requirements of all types of process tanks, waste heat recovery, etc. Bul. P61.

17-18 *Tranter Mfg. Inc.

*From advertisement, this issue

LITERATURE . . .

Kilns, Rotary.....Bulletin No. 1115 gives complete information on these kilns as well as details of the precision built & rugged machinery for the chemical processing industry. 48 *Traylor Engineering & Mfg. Co.

Steam Generators.....feature controlled circulation. Delivers up to 6½ hp per square foot of floor area, with as little floor load as 130 lbs. per square foot. Facts. 166 *Clayton Mfg. Co.

Steam Traps.....The 44-page book gives specific data on the selection & sizing of traps. Also information on design & construction of Inverted Bucket Steam Traps. 171 *Armstrong Machine Works

Vaporizers.....both packaged & field erected, can be outfitted for heating with oil, gas, waste heat or special fuel in outdoor & indoor installations. Bul. "DV". 170 *Union Iron Works

Instruments & Controls

Controls.....Printweigh "400" for complete printed weight records. It prints full figures, even when unit weights are used. Complete details in Bulletin 2017. 196 *Toledo Scale Corp.

Controls, Temperature.....Self-Powered Controls maintain continuous watchdog duty over processing temperatures. A 10-page Control Bulletin is offered. No. 620. 40 *Sarco Company, Inc.

Gauges.....Complete details on Tank Content Gauges are now available. All models feature large easy-to-read dials. Remote reading . . . no power required. TL195 *The Liquidometer Corp.

Instrumentation.....Four new bulletins provide detailed information about company's recorders for pressure and temperature, charts and planimeters and orifice meters. 191A *American Meter Co.

Thermowell Materials.....New 4-page guide aids thermowell users in selecting proper thermowell material for a given application and operating condition. 191B *Thermo Electric Co.

Transmitters.....Two new f/b line models permit new accuracy in measuring flow & differential pressure. Applications for steam, air, gases, water, etc. Information. 28 *Bailey Meter Co.

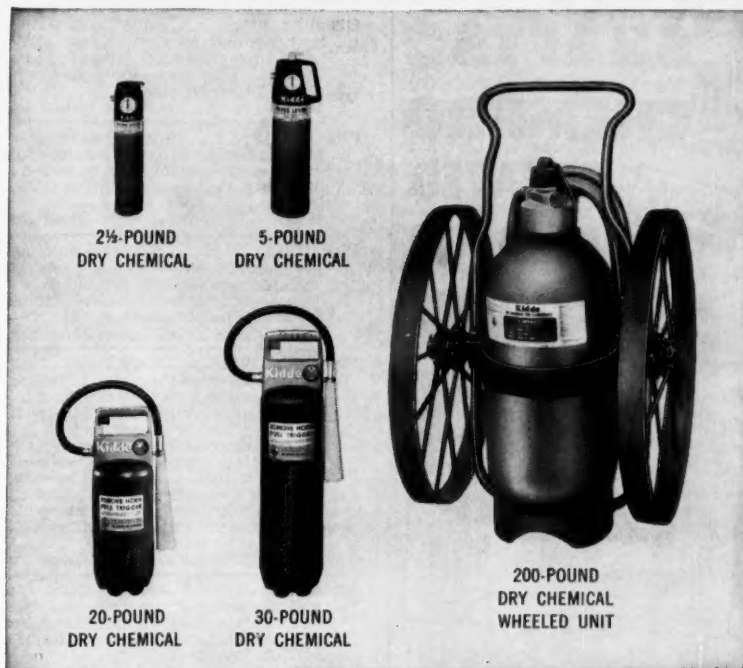
Vapor Fractometer.....offers complete separation of Methyl Esters of C18 Fatty Acids. Product Information & 4 technical reprints on gas chromatography are offered. 77 *Perkin-Elmer Corp.

Pipe, Fittings, Valves

Butt Weld Fittings.....Sanitary fittings & valves are outlined in Catalog W-159. Contains illustrations, specifications and complete data for all requirements. 191C *Ladish Co., Tri-Clover Div.

* From advertisement, this issue

Now! FULL-POWER Fire Fighting with this complete dry chemical line!



Kidde top-rated portables and wheeled units kill more fire...faster!

From the powerful new 2½-pound portable, on up to the giant 200-pound wheeled unit, Kidde dry chemical extinguishers pack the *extra* punch needed for stubborn blazes, for *full-power* fire fighting. Available in pressurized 2½, 5, 10, 20 and 30-pound capacities, Kidde dry chemical portables feature simple, one-two operation, are easiest of all portables to operate, even while wearing gloves. Kidde portables have no valves to turn, no pins to pull, need no bumping or inverting. Just aim, pull trigger, and fire's out! All are quickly and easily pressurized, have dust- and moisture-proof gauges which show at a glance when unit is charged.

The 200-pound Kidde pressurized wheeled unit discharges a 40-foot dry chemical stream faster, has an *extra* 50 pounds of fire-smothering dry chemical to knock down fire quicker. It's faster and easier to operate . . . just remove pin, swing toggle lever, and flip on-off lever. Easy to maneuver because of its low center of gravity and larger wheels. Truly a one-man fire engine!

All Kidde extinguishers are granted top rating by Underwriters' Laboratories, are the finest extinguishers on the market today. Get more information about this *complete* line of *full-power* fire fighting equipment. Write to Kidde today!

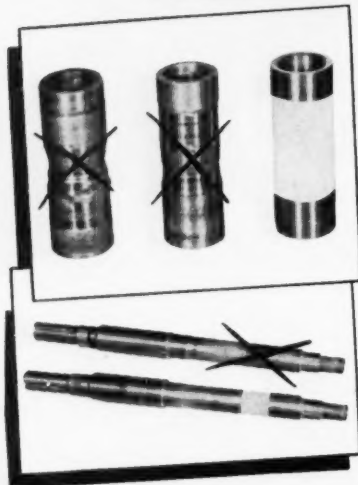
Kidde



Walter Kidde & Company, Inc.
228 Main St., Belleville 9, N. J.

Walter Kidde & Company of Canada Ltd.
Montreal—Toronto—Vancouver

Eliminate "CHEWED UP" SHAFTS with CHEMPRO NEW SPRAYED CERAMIC SERVICE



Chempro's new extremely hard, chemically inert ceramic coatings applied to shafts and shaft sleeves eliminate the costly failure of "chewed up" or "scored" shafts and sleeves. Sprayed ceramic surfaces are highly resistant to abrasion, erosion and fretting corrosion under even the most difficult slurry service. They also give ideal protection against shaft wear under high packing gland pressures.

Pump down-time due to shaft or sleeve failure has been drastically reduced in every installation in which Chempro's sprayed ceramic surfacing has been used.

Write for new Chempro Bulletin CP28 for ordering information.



5 Broadway, New York 4, N. Y.

LITERATURE . . .

Fittings, Stainless Steel. Screwed & socket weld, 2000 lb., 3000 lb. & 6000 lb. feature; sharp clean threads, smooth interior surfaces, uniform wall thickness, etc. Cat. 162 *Camco Fittings, Inc.

Graphite Pipe. Bulletin discusses new modular concept in corrosion-proof impervious graphite pipe and fittings. Pipe is armored in fiberglass; 72-in. lengths. 192A Falls Industries

Pipe Hangers. Spring hangers with patented internal swivel action provide 2-way control over movement of piping. Full information in Catalog #54. 161a *Blaw-Knox Co.

Pipe, PVC. Rigid Koroseal pipe has the highest impact resistance of any thermoplastic pipe, but won't corrode, is easy to install. Additional facts in Pipe & Sheet Booklets. 1 *B. F. Goodrich Industrial Prod.

Pipes. Bulletin CE-56 gives facts on all-purpose rigid PVC. Sched. 40, 80, & 120 in 1/2" to 4". Also information on solket-weld fittings & valves 1/2" to 2". 153a *American Hard Rubber Co.

Pipe, Flexible Poly. ideal for water lines, drains, underground pipe or conduit. Sizes 1/2 to 2", long coils. Additional information in Bul. CE-57. 153c *American Hard Rubber Co.

Piping. Type S piping systems can end problems of corrosion, erosion & contamination. Liner & housing are in thermal equilibrium. Details in Bul. TS-1A. 139 *Resisto-Flex Corp.

Rupture Discs. offer wider rangeability in selection of metals & plastics for disc components. Feature rugged construction for protection against damage. Details. 183a *Black, Sivalls & Bryson, Inc.

Safety Head. provides an instantaneous, unrestricted opening when pressure-relief requirement is greater than discharge capacity of valve. Detailed information. 183b *Black Sivalls & Bryson, Inc.

Thermo Panels. take the place of pipe coils. Can be quickly installed or removed for cleaning. Complete data, including prices is available on request. TL193 *Dean Products, Inc.

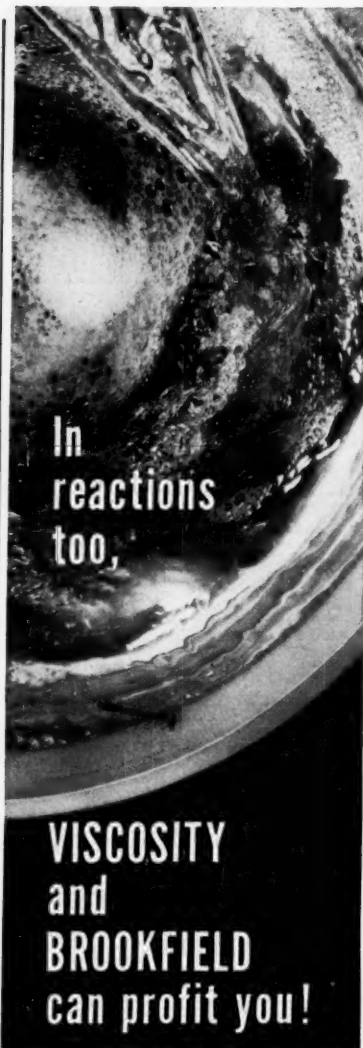
Valve. The new "O-Seal" valve features two teflon "O" rings in the plug which give constant vapor-tight shut-off. A new brochure on these valves is offered. 137 *Wedgeplug Valve Co.

Valve Controls. New Type SA Limit-torque unit incorporates unique compensatory springs. Features greater torque, thrust & stem capacity. Data in Bulletin 4-57. 16 *Philadelphia Gear Corp.

Valves, Air Actuated. meet a wide range of dairy, food & beverage industries processing operations. Basic dimensions & flow diagrams in Bulletin A-658. 192B Ladish Co., Tri-Clover Div.

Valves, Ball. The new "316" gives positive sealing over a wide range of pressures. Complete line of Ball Valves are described in a new catalog. 169 *Rockwood Sprinkler Co.

* From advertisement, this issue



In
reactions
too,

VISCOSITY
and
BROOKFIELD
can profit you!

It's true. In-process viscosity measurement is the most direct progress report of many chemical reactions that you can obtain. In polymerization reactions, for example, Brookfield process-mounted Viscometran units eliminate the need for constant sampling, assure greater product uniformity and guard against run-away reactions.

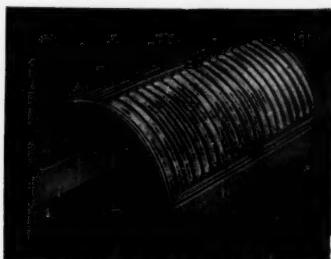
Like color, pH and stability the viscosity of any material is a vital property, a fundamental measurement, which can be easily and accurately evaluated and controlled with low-investment Brookfield instrumentation.



the world's standard for viscosity measurement

Brookfield

ENGINEERING LABORATORIES INCORPORATED
STOUGHTON 13, MASSACHUSETTS



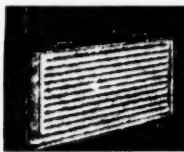
HOW TO ELIMINATE PIPE COILS

Issue after issue, year after year, in **CHEMICAL ENGINEERING**, we have been telling you how to save money by eliminating old-fashioned pipe coils. Simply install the



**DEAN®
THERMO-PANEL
COIL**

The above photo shows how a Dean Thermo-Panel Coil was curved to fit a round tank. More economical, by far, than is possible with old-style pipe coils. The first cost is usually much less.



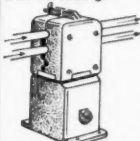
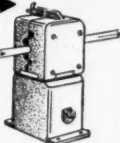
A Typical Flat Panel. Type AP tell us about it.
Backed by 20 Years of Panel Coil Manufacturing

DEAN THERMO-PANEL COIL DIVISION
DEAN PRODUCTS, INC. 612 Franklin Ave.
BROOKLYN 38, N. Y. Tel. Sterling 9-5400

PUMPING IDEAS POSSIBLE ONLY with a SIGMAMOTOR PUMP

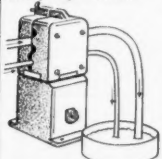
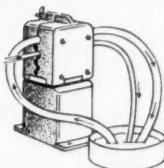
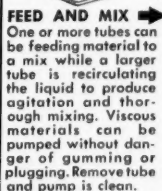
MOVE CORROSIVE LIQUIDS

Material being pumped never comes in contact with pump mechanism. Wave-like motion of steel fingers forces material through Tygon tubing. By changing size of tubing, capacity can be increased or decreased. Pump housing opens for removal and insertion of tubing.



PUMP 2 OR 3 DIFFERENT LIQUIDS SIMULTANEOUSLY

Some models will accommodate up to four tubes so that four different liquids can be passed through the pump at one time without danger of contamination.



METER ADDITIVES
One or more additives can be pumped to a solution in the exact amount desired by selecting the correct size of tubing and regulating pump speed. Various controls can be incorporated to close valves ahead of pump.

Capacities from 0.5 cc. per min. to 4.5 G.P.M.
Write for complete information on sizes, capacities.
SIGMAMOTOR, INC.

17 N. Main Street • Middleport, N. Y.

LITERATURE . . .

Valves, Ball will provide leak-proof sealing in long, trouble-free service. Features quarter-turn opening & closing. For information see Catalog 1000.
67 *W-K-M, ACF Division

Valves, Blow-Off New Bulletin B-435, Supplement A, describes manufacturer's tandem blow-off valves for boiler blow-off pressures to 665 psi.
193A Yarnall-Waring Co.

Valves, Control for hot or cold flows . . . or other process flow conditions. Available in a wide range of types and sizes. New Catalog C800-1 is offered.
30 *Minneapolis-Honeywell

Valves, Diaphragm Packless valves are widely used in processing industries where absolute tightness is necessary to prevent leakage. Complete information available.
103 *Crane Company

Valves, Diaphragm New bulletin contains many helpful items that should be considered when selecting diaphragm valves for process piping. Typical applications.
193B Huls-McCanna Co.

Valves, Drain cannot clog up. Designed so that in the closed position the piston or ram extends up into the tank. In open position, full flow assured. Catalog.
L174 *Strahman Valves, Inc.

Valves, Gate in sizes, types and metals for all kinds of normal or unusual services. No wedging pressure during gate travel. Catalog No. 57 gives details.
178 *Darling Valve & Mfg. Co.

Valves, Plug Lubricated Plug valves are available in sizes 1/2" through 16", depending on the type required. Features 3 basic parts, Body, Bonnet, Plug.
73 *The Wm. Powell Co.

Valves, Rotary Bulletin N-578 gives complete information about style "A" rotary valves. Includes construction features, specifications, dimensions & applications.
176e *The Day Company

Valves, Stainless Steel A new catalog outlines patterns you want, in a choice of alloys that satisfy the requirements of practically all corrosive services.
27 *Jenkins Bros.

Welding Fittings Available in sizes 1/2" through 24". Schedules 5S through 160. Stainless types 304, 304L, 316, 316L, 347; Monel, Nickel, Aluminum.
6 *Flowline Corp.

Process Equipment

Automatic Batching Systems Brochure describes the latest product developments in the field of batching control. Emphasis on remote setting of formulas.
193C Toledo Scale Corp.

Blender, Ribbon designed to give top mixing efficiency & meet sanitary codes. Nine different size units ranging from 16 to 300 cu. ft. working capacity.
89 *The Strong Scott Mfg. Co.

* From advertisement, this issue

NO MAJOR REPAIRS IN 25 YEARS*

Sturtevant Construction Assures Long Mill Life at Top Loads

Sturtevant crushing and grinding machinery answers the long life top-load production problem for medium to small size plants. Many Sturtevants have been operating above rated capacities for more than 25 years, and without a major repair.

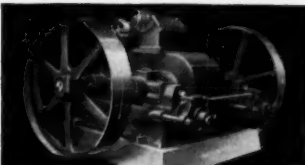
"Open-Door" design gives instant accessibility where needed — makes cleanouts, inspection and maintenance fast and easy. Machines may be set up in units to operate at equal quality and capacity.



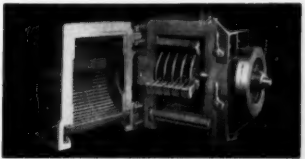
Jaw Crushers — Produce coarse (5 in. largest model) to fine (1/4 in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smallest sizes operate on double cam principle — crush double per energy unit. Request Bulletin No. 062.



Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to 1/4 to 1 1/4 in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. Request Bulletin No. 063.



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. Request Bulletin No. 065.

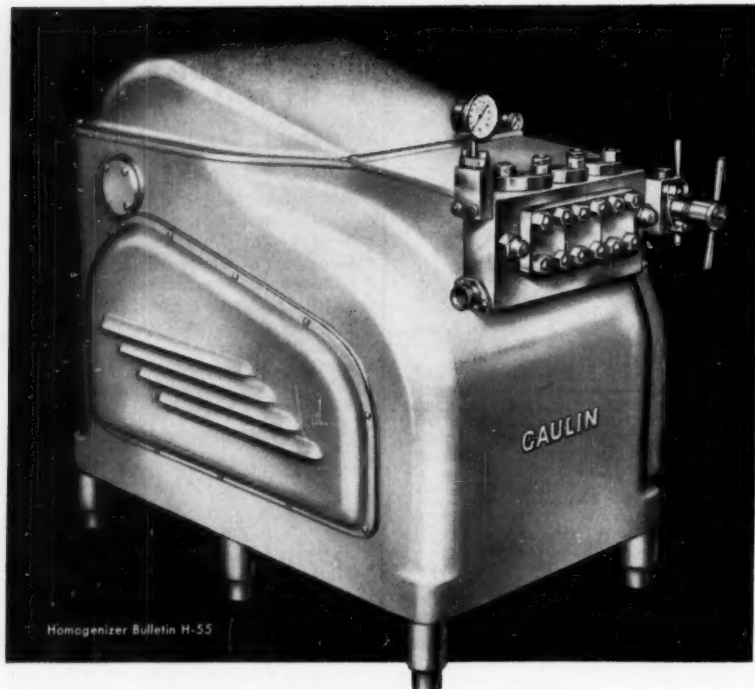


Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30 1/2 in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12 1/2 x 24 in. Request Bulletin No. 084.

* Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.

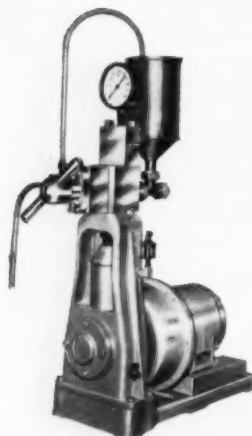
STURTEVANT MILL COMPANY

100 Clayton St., Boston 22, Mass.

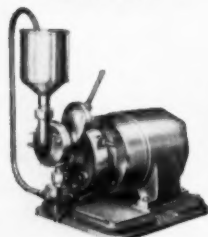


Homogenizer Bulletin H-55

What Goes On In This GAULIN HOMOGENIZER Can Save You Money in Blending, Dispersing, Emulsifying



Laboratory Homogenizer
Bulletin LH-55



RE Colloid Mill Bulletin C-57

Gaulin Particle Control . . . the skill of knowing the one best way to disperse, emulsify or blend . . . can bring dollar savings to your processing.

Homogenizer, Sub-Micron Disperser or Colloid Mill . . . members of the GTA team . . . can improve mixing or blending to such a degree that ingredient costs can be reduced, product quality improved, difficult formulas homogenized.

It's no secret, but it takes know-how: That's what GTA . . . Gaulin Technical Assistance . . . is for. Send us your problems or write for Technical Bulletins H-55, LH-55, D-55, and C-57. Or if you prefer to try Particle Control in your plant, rent a Gaulin Laboratory Homogenizer or Colloid Mill for only \$75.00 a month.



71 Garden Street, Everett 49, Mass.

World's Largest Manufacturer of stainless steel, reciprocating, rotary, pressure exchange pumps, dispersers, homogenizers and colloid mills.

LITERATURE . . .

Centrifugal Tornado-Matic centrifugal gives contamination-free service and is fully adjustable as to pressure & speed. Offers smooth unloading of difficult products.
188 *The Fletcher Works, Inc.

Centrifugals Catalog CE-58 gives complete information on size, type and capacities of "Ter Meer" centrifugals. Designs for every process in the chemical industry.
31 *Baker Perkins, Inc.

Dissolvers for ultimate dispersion, dissolving, emulsifying & deagglomerating in processing solid-liquid, liquid-liquid & gas-liquid materials. Information in catalog.
179 *Morehouse-Cowles

Dryer Hydrier continuously removes moisture from gas or air stream at full line pressures. Bulletin gives application details, selection tables, etc.
TL209 *J. F. Pritchard & Co.

Dryers & Mixers Units are fabricated of stainless steel & are self-contained. Technical assistance is available. Further information is yours on request.

26 *General American Transp. Corp.

Dust Collector The W Roto-Clone requires little maintenance, uses a minimum of water & maintains efficiency regardless of variation in air volume. Bul. 272B.
44 *American Air Filter Co.

Dust Collectors Cyclones feature large-diameter design that eliminates bridging & clogging. Booklet, "The Exclusive Buell Cyclone" for complete information.
189 *Buell Engineering Co.

Dust Collectors Complete, low cost unit designed for plants or applications where central dust control systems are not practical. Bulletin 510.
176F *The Day Company

Dust Collectors Application handbook describes a wide range of industrial dust and fume producing processes that can be controlled with bag-type collectors.
194A Wheelabrator Corp.

Filter Cloth Wedge shaped openings allow only the filtrate to pass through. Available in a variety of weaves in all malleable metals. New Catalog E is offered.
180 *Newark Wire Cloth Co.

Filter, Dust Complete specifications, typical equipment layouts, capacity & performance of the Reverse Jet Dust filter are contained in Bulletin F-75.
176D *The Day Company

Filter leaves Bulletin No. 583 contains complete information on the many different properly designed filter leaves.
BL195

*Multi-Metal Wire Cloth Co., Inc.

Filters A new catalog is offered with complete details on Fulflo filters. They provide true depth filtration at minimum pressure drop for liquid chemicals, etc.
32 Commercial Filters Corp.

Filters, Dust Bulletin G-579 describes type "RJ" filter. Gives operating features, dimensions & complete specifications on this all purpose unit.
176A *The Day Company

* From advertisement, this issue

DEPENDABLE 100% AUTOMATIC

REMOTE READING Tank Contents Gauges

- RELIABLE
- NO POWER REQUIRED
- UNDERWRITERS' APPROVED

Liquidometers use a temperature compensated balanced hydraulic system. Indications unaffected by changes in specific gravity. All models feature large easy-to-read dials. UL approved switches available.

Write for complete details to
Dept. Q.

Since 1920



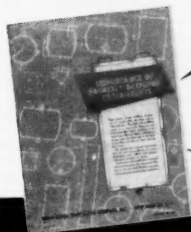
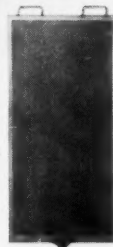
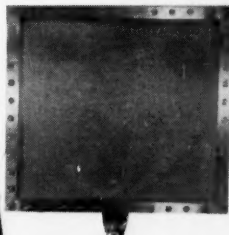
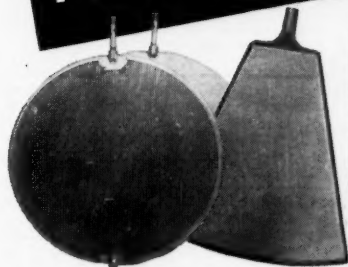
of proven quality



THE LIQUIDOMETER CORP.
LONG ISLAND CITY 1, NEW YORK

Engineered for better filtration

**MULTI-METAL
PROPERLY DESIGNED
FILTER LEAVES**



Write for
Bulletin No. 583

To assure your filter's maximum operating efficiency and economy, get to know how Multi-Metal's vast experience in designing and making filter leaves can help you meet your needs best. You'll find it pays.

MULTI-METAL WIRE CLOTH CO., Inc.

1353 GARRISON AVENUE, NEW YORK 59, N. Y.

EVERY TYPE OF CUT GEAR FOR EVERY INDUSTRIAL PURPOSE

SINCE 1888... We have been making many types and sizes of gears for industry. During these passing years we have derived considerable experience, trained numerous personnel, and expanded our mechanical and plant facilities—and have remained under one continuous management. We are ready to ably serve you.



HERRINGBONE



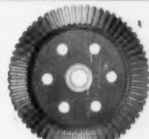
WORM GEAR



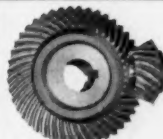
SPUR GEARS



HELICAL GEARS



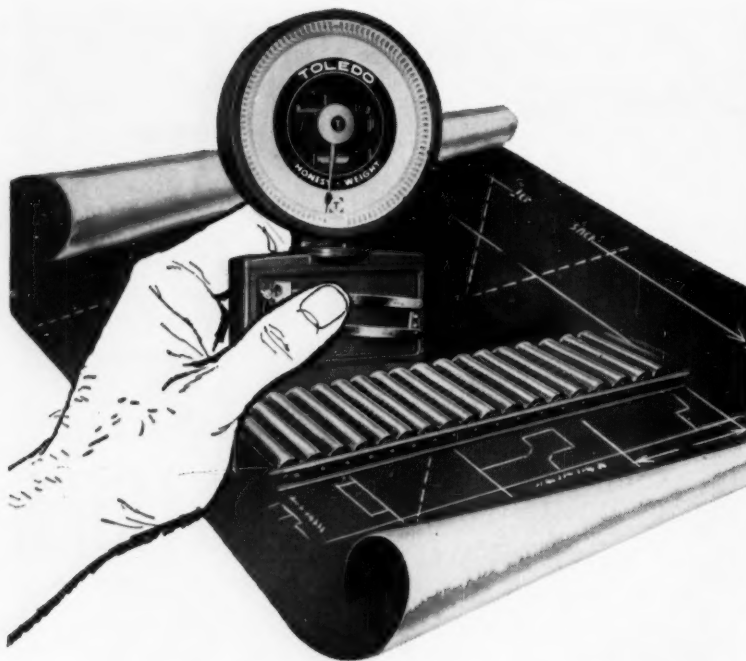
BEVEL GEARS



SPIRAL BEVEL

D.O. James
ESTABLISHED 1888

D. O. JAMES GEAR MANUFACTURING CO.
1140 W. Monroe Street, Chicago 7, Ill.

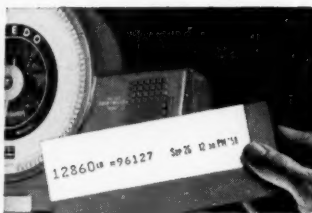


**the cost-saving trend today
puts **BETTER CONTROL**
where it counts most!**

On industry's scales, materials become money. Weight records directly affect costs, quality, inventories and customer billing. That's why it is so vitally important to put *Toledos* at all weighing points . . . where control counts most!

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LITERATURE . . .

Filters Mechanical. . . . Bulletin gives information on three types of high-efficiency mechanical filters. These are the Type F, Deep Bed and Multi-Pak dust collectors.
196A American Air Filter Co.

Filtration Equipment. . . . Many types of pressure filters-filter presses, vertical leaf filters, horizontal plate filters & others. Literature is available.
182 *T. Shriver & Co., Inc.

Grinding Plant. . . . Plant components are designed, applied & "coordinated" to handle materials in a 30 to 300 lb. per cu. ft. range. Details available.
25 *Allis-Chalmers

High Vacuum Equipment. . . . A 35-page catalog showing and describing many ways to improve your vacuum operations is now available on request. Catalog 1462.
R-198 *C. H. Wheeler Mfg. Co.

Homogenizers. . . . Technical bulletins with information on the Homogenizer, Sub-Micron Disperser or Colloid Mill are now available for all processing problems.
194 *Manton Gaulin

Ion Exchange. . . . for the purification of literally hundreds of chemical products. Details covering an analytical economics study are available. Bulletin 200.
129 *Industrial Filter & Pump Mfg.

Mill, IMP. . . . is equipped with flash drying accessories for removing moisture while pulverizing the material. Catalog 87 outlines all the features.
104 *Combustion Engineering, Inc.

Mills, Impact. . . . available in all sizes. A new bulletin tells most efficient method of achieving particle size reduction by centrifugal force.
196B Safety Industries, Entoleter Div.

Mills, Roller. . . . Designed for quality fine grinding . . . 20 mesh to 400 mesh . . . micron sizes on some materials. Exclusive gearless & spur gear drives. Facts in catalog.
45 *Williams Patent Crusher

Mixer. . . . Bulletin 730 discusses the theory of mixing and compares the range of operations of different types of mixing equipment. Tables assist size selection.
196C Inflico Inc.

Mixers. . . . A full line . . . side drive, tank top, portable or tripod & continuous pipeline mixers etc. For all your fluid mixing needs, Bulletin 582.
69 *New England Tank & Tower Co.

Mixers, Centrifugal. . . . New principle of high speed mixing producing intimate dispersion. Available in all sizes to meet individual needs.
196D Safety Industries, Entoleter Div.

Mixers, Dispersion. . . . Available in a complete range of laboratory & production sizes, ¼ to 300 gal. capacities, ¼ to 150 hp. drives. Detailed information offered.
158 *The J. H. Day Co.

Mixers Horizontal. . . . New, complete line of horizontal mixers is covered by a new 12-page bulletin. Complete dimensions for capacities of up to 500 cu. ft.
196E The Young Machinery Co.

* From advertisement, this issue

LITERATURE . . .

Pressure Vessel. . . . Design Handbook covers a complete range of pressure vessels up to 131% I. D. & 844 pounds psi working pressure. Available now.
160 *American Car & Foundry

Processor, Round. . . . used for heating, pasteurizing, cooking, mixing, cooling, holding, setting, refrigerated storing & air unloading. Information on equipment available.
105 *Cherry-Burrell Corp.

Separator, Dust. . . . Bulletin 576 outlines the "HV" heavy duty dust separator. This separator offers rugged construction for your dust control requirements.
176C *The Day Company

Separators, Dust. . . . Dual-Clone dust separators are noted for their low resistance & high cleaning efficiency. Easy to install, no maintenance, no moving parts. Bul. 573.
176B *The Day Company

Screens, Vibrating. . . . Bulletin outlines the new design and high capacities for long life under rugged conditions. Available in all sizes.
197A
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Pumps, Blowers, Compressors

Air Jet Generator. . . . helps solve defoaming problems. Full information on this new economical approach to perfect defoaming contained in Bulletin RB-12.
R209 *Gulton Industries, Inc.

Belted Vent Sets. . . . Where a quiet fan or a package unit is desired. Available in capacities from 500 to 20,000 cfm. Full information in Bulletin 3720-A.
24B *Buffalo Forge Co.

Blowers. . . . How units of the manufacturer's series of rotary positive-pressure blowers and gas pumps handle problems is the topic of Bulletin S-59G.
197B Sutorbilt Corp.

Compressors. . . . Ro-Flo compressors are available in 2-stage units in range from 250 to 1800 cfm. Single stage units from 40 to 3000 cfm. Descriptive literature.
46 *Allis-Chalmers

Compressors. . . . Bul. 167-11 outlines oil-free compressors. These compressors use carbon piston rings that require no lubrication. No oil in cylinder or in compressed air.
7 *Joy Manufacturing Co.

Compressors. . . . A new 12-page bulletin describes G single-stage, YS single-stage, and YC two-stage compressors.
197C Le Roi Div., Westinghouse Air Brake

Fans, Industrial. . . . Bulletin I-585 includes helpful selection charts, capacity tables, dimensions & specifications. Also information on special types & arrangements.
176G *The Day Company

Industrial Exhausters. . . . are available in a wide variety of models, capacities & arrangements to handle air or material handling jobs. Bulletin 3576-B.
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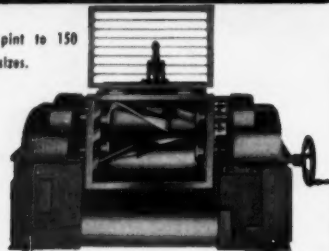
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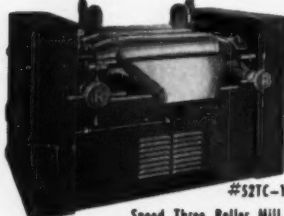
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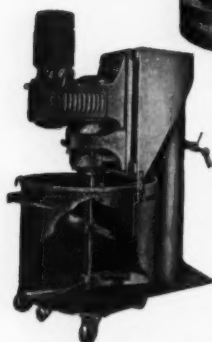


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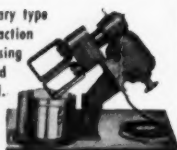


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135 *Goulds Pumps, Inc.

Pump. . . . Bulletin 440 outlines typical applications, flow charts, description & specifications of Pulsafeeder models of various capacities & construction.
53 *Lapp Insulator Co., Inc.

Pump Gear. . . . Improved design . . . now 12 gph. All wetted parts are acid-resistant and wear-resistant. For complete details on these gear pumps. Bulletin CE-55.
153B *American Hard Rubber Co.

Pump, Screw. . . . Bulletin 206 is devoted exclusively to standard & hopper types of double external bearing & gear screw pumps. Contains illustrations & dimensions.
198A Warren Pumps, Inc.

Pumps. . . . New line of vertically-split, single-stage, single-suction pumps handles temperatures to 300 F. and pressures to 600 psi. Form 7494 describes line.
198B Ingersoll-Rand

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T207 *Viking Pump Co.

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198C Ingersoll-Rand

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156 *J. J. Stokes Corp.

Services, Processes, Misc.

Centralized Lubrication. . . . Bul. 101 illustrates & describes the application of centralized lubrication systems to a dozen types of equipment—shovels, mills, cranes, etc.
63 *The Farval Corporation

Cleaning Service. . . . Known as a bundle-jetting tool, new device speeds cleaning of the external surfaces of heat exchanger tube bundles. Bulletin.
198D Dowell

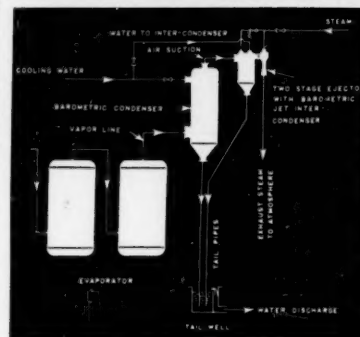
Electron Microscopes. . . . 12 p. "Questions & Answers on Electron Microscopes" covers magnification, resolution, specimen preparation, fields of application.
198E Philips Electronics Inc.

Engineering Service. . . . Four-Fold Engineering Service program offers a comprehensive survey of your facilities, installation supervision, etc. Details available.
8-9B *Becco Chemical Div., FMC

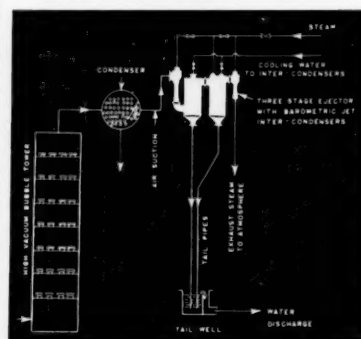
Equipment, Iron. . . . Catalog A-9 presents a complete engineering picture, descriptions, specifications, and data on blinds, spacer rings, strainers & flanges.
TL199 *The Mack Iron Works

* From advertisement, this issue

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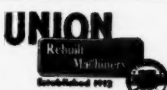
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- 1—Struthers Wells SS Calandria type evaporator, 365 sq. ft.
- 1—Swenson single effect evaporator, SS, 320 sq. ft.
- 1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
- 1—Swenson type 316 SS vacuum crystallizer, 2'6" x 12'

AUTOCLAVES, KETTLES AND REACTORS:

- 1—100 gal. type 316 SS jacketed reactor, 150# internal pressure, 75# jacket with impeller type agitator
- 1—Walter SS jacketed reactor, 500 gal.
- 4—Plaudler 750 gal. SS jacketed reactors
- 5—Plaudler 500 gal. SS jacketed reactors
- 1—Tippett & Wood 2500 gal. jacketed steel kettle
- 1—Horizontal 5000 gal. nickel storage tank
- 1—Columbia Engineering high pressure storage tanks, 2400 gal., 265# working pressure
- 1—18000 gal. type 347 SS vertical tank
- 1—Struthers Wells type 316 SS 4000 gal. tank

DRYERS:

- 4—Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20, 604-20
- 1—Bullovak double drum dryer, 42" x 120"
- 1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
- 1—Stokes double drum dryer 5' x 12'
- 1—Louisville rotary steam tube dryer 8' x 45'
- 1—Louisville SS rotary kiln, 30" x 28", complete
- 1—Stokes SS rotary vacuum dryer, 2' x 6'
- 6—Stokes steel jacketed rotary vacuum dryers, 3' x 15'
- 1—Stokes SS rotary vacuum dryers, 3' x 15'
- 3—Louisville SS rotary dryers, 8' x 50'

FILTERS:

- 1—Oliver horizontal filter, 6' 6"
- 1—Sweetland #3 SS filter
- 1—Niagara SS filter Model 510-28
- 1—Oliver horizontal filter, 3'
- 1—Feinc SS rotary vacuum string filter, 3' x 3' (NEW)
- 10—Shriver plate and frame filter presses, 12" to 42"
- 1—Shriver rubber lined filter press 36" x 36"
- 12—Sweetland #12 Filters with 72 SS leaves

MIXERS:

- 5—Baker Perkins double arm sigma blade mixers, 100 gal.
- 3—Robinson type 316 SS sigma type jacketed heavy duty mixers, 300 gal. 60 HP
- 3—Howes 40 cu. ft. rubber covered ribbon blenders
- 1—Leader SS jacketed 51 cu. ft. ribbon blender
- 1—Readco SS double arm jacketed sigma blade vacuum mixer, 10 gal. working capacity

MISCELLANEOUS:

- 2—Heat Transfer Products steel bubble cap columns, 36" and 42" with 5 and 10 trays
- 1—Acme steel bubble cap column 42" dia. with 10 trays
- 1—Downington Iron Steel bubble cap column 24" dia. with 14 trays
- 2—Patterson Kelley, steel heat exchangers, 1000 sq. ft. each
- 6—Struthers Wells heat exchangers, 885 sq. ft.
- 1—Patterson Kelley steel heat exchanger, 427 sq. ft.
- 50—Steel heat exchangers from 15 sq. ft. to 400 sq. ft.
- 30—Struthers Wells SS heat exchangers, 650 sq. ft. each
- 1—Struthers Wells type 316 SS heat exchanger, 330 sq. ft.
- 2—Stokes tablet presses, Model T
- 1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
- 1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
- 1—Stokes Model DDS2 rotary tablet press
- 1—Bird type 316 SS 48" suspended type centrifuge with perforated basket and fume type cover
- 2—Badger type 316 SS bubble cap column, 36" dia. with 7 trays

- 5—2900 gal. type 316 SS jacketed reactors, complete with agitators and Turbo drives
- 7—Robinson 230 cu. ft. type 304 SS ribbon blenders
- 6—Davis Engineering type 316 SS heat exchangers, 170 sq. ft. (NEW)
- 1—Vulcan type 347 SS bubble cap column, 4' dia. x 35', 30 trays

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Unnotched	@ 72°F	22.0
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TENSILE STRENGTH PSI.	140°F	5800.0
TENSILE STRENGTH PSI.	220°F	2000.0
FLEXURAL MODULUS PSI. x 10 ⁵		3.5
ROCKWELL R HARDNESS		110.0
SPECIFIC GRAVITY		1.06
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INDEX OF

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Allegheny Ludlum Steel Corp..	167
Allis-Chalmers Mfg. Co.	
General Machinery Div....	25, 46
	85, 97
Aluminum Co. of America	
Electrical Div.	22
American Air Filter Co.....	42
American Car & Foundry Div. of	
ACF Industries, Inc.....	160
American Hard Rubber Co....	152, 153
American Machine and Metals..	164
	165
American Optical Co.....	44
Annin Company	181
Appleton Electric Co.....	56
Armco Steel Corp.	47
Armstrong Machine Works.....	171
Bailey Meter Co.....	28
Baker Perkins, Inc.	31
Becco Chemical Div., Food	
Machinery & Chemical Corp...	8-9
Bethlehem Steel Co.....	157
Bird Machine Co.....	2
Black, Sivalis & Bryson	
(Safety Head)	183
Blaw-Knox Co.	
Power Piping & Sprinkler Div.	161
Boardman Co.	197
Bridgeport Brass Co.	102
Brookfield Engrg. Laboratories..	192
Buell Engineering Co.....	189
Buffalo Forge Co.....	24
Cambridge Wire Cloth Co.....	81
Camco Fittings, Inc.....	162
Carlson Inc., G. O.	51
Celcote Co.	172
Chemical & Power Products.....	192
Cherry-Burrell Corp.	105

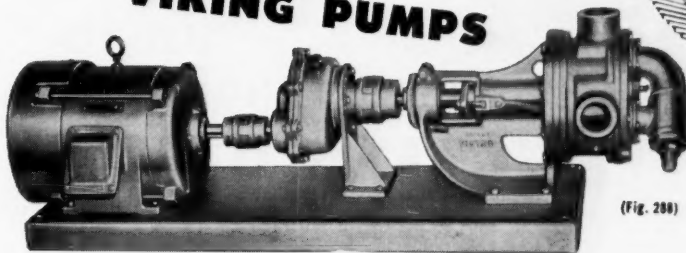
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ADVERTISERS

Chicago Bridge & Iron Corp.	Second Cover
Clayton Mfg. Co.	166
Combustion Engineering, Inc.	
Raymond Division	104
Commercial Filters Corp.	32
Coppus Engineering Co.	21
Crane Co.	103
Crane Packing Co.	154
Darling Valve & Mfg. Co.	178
Day Co., J. H.	158
Day Co., The	176
Dean Products, Inc.	
Dean Thermo-Panel Coil Div.	193
DeZurik Corp.	39
Dorr-Oliver, Inc.	58-59
Dracoo Div. of	
The Fuller Co.	50
du Pont de Nemours & Co., Inc., E. I.	
Polychemicals Dept. (Teflon)	87
Duraloy Co.	190
Duriron Company, Inc., The	147
Elliott Company	143, 168
Emery Co., A. H.	75
Enjay Company, Inc.	71
Farval Corp.	63
Fisher Governor Co.	150, 151
Fletcher Works, Inc.	188
Flowline Corp.	6
Foxboro Co.	91
Fuller Co., The	36
General American Transportation Corp., Kanigen Div.	96
Louisville Dryer Div.	26
General Chemical Division	
Allied Chemical Corp.	61
Gordrich Industrial Products Co., B. F. (Koroseal)	1
Goslin-Birmingham Mfg. Co.	184
Goulds Pumps Co.	135
Graver Tank & Mfg. Co.	175
Gulton Industries, Inc.	209
Harbison-Walker Refractories Co.	133
Haynes Stellite Co., Div. of Union Carbide Corp.	145
Hercules Powder Co.	19
Hooker Chemical Corp.	159
Hough Co., Frank G.	34
Industrial Division, American-Standard	41
Industrial Filter & Pump Mfg. Co.	129
Ingersoll-Rand	79
James Mfg. Co., D. O.	195
Jeffrey Mfg. Co.	210
Jenkins Bros.	27
Johns-Manville Corp.	
Insulation	10-11
Joy Manufacturing Co.	7
Kennedy Van Saun Mfg. & Engrg. Co.	174
Kidde & Co., Walter	191
Killark Electric Mfg. Co.	23
LaBour Co.	93
Ladish Co.	95
Lapp Insulator Corp. (Pulsafeeder)	53
Layne & Bowler Co.	43
Limitorque Corp.	16
Linde Co., Div. of Union Carbide Corp.	131
Link-Belt Co.	4
Liquidometer Corp.	195
Lithco Corp.	163
Luzerne Rubber Co.	208
Mack Iron Works	199
Manton Gaulin Mfg. Co.	194
Midwest Piping Co.	29
Minneapolis-Honeywell	30
Morehouse-Cowles Co.	179
Multi-Metal Wire Cloth Co.	195
Nash Engineering Co.	94
Newark Wire Cloth Co.	180
New England Tank & Tower Co.	69
Niagara Filters Division	165
Nicholson & Co., W. H.	20
Norton Company	33
Olin Mathieson Chemical Corp.	155

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(Fig. 208)

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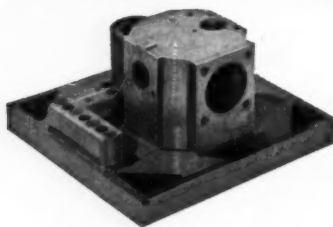


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ADVERTISERS . . .

Perkin-Elmer Corp.	77
Pfautler Co., Div. of Pfautler	
Permutit, Inc.	Fourth Cover
Philadelphia Gear Corp.	16
Powell Valves, Wm. Powell Co.	73
Pritchard & Co., J. F.	209
Raybestos-Manhattan, Inc.	
Plastics Div.	173
Reliance Electric & Engrg.	
Corp.	Third Cover
Republic Steel Corp.	14-15
Resistoflex Corp.	139
Rockwood Sprinkler Co.	169
Rolock, Inc.	207
Ross & Son, Charles.	198
Ryerson & Sons, Inc., Joseph T.	106
Sarco Co.	40
Seiberling Rubber Co.	206
Sel Rex Corp.	208
Shriver & Co., T.	182
Sigamotor, Inc.	193
Solvay Process Div.	
Allied Chemical Corp.	83
Stockham Valves & Fittings.	137
Stokes Corp., F. J.	156
Stone & Webster Engrg. Corp.	35
Strahman Valves, Inc.	174
Strong-Scott Mfg. Co.	89
Sturtevant Mill Co.	193
Sun Shipbuilding & Dry Dock	
Co.	52
Thermo Electric Co.	209
Toledo Scale Div. of	
Toledo Scale Corp.	196
Tolhurst Centrifugals	164
Tranter Mfg. Co., Platecoil Div.	17-18
Traylor Engineering & Mfg. Co.	48
Union Iron Works.	170
U. S. Rubber Co.	149
U. S. Stoneware Co.	54
Viking Pump Co.	207
Vogt Machine Co., Henry	127
Wagner Electric Corp.	141
Welding Fittings Corp.	
(Flowline Corp.)	6
Westinghouse Electric Corp.	12-13
Wheeler Mfg. Co., C. H.	198
Williams & Co., C. K.	177
Williams Patent Crusher &	
Pulverizer Co.	45
WKM Division of	
ACF Industries, Inc.	67
Yarnall-Waring Co.	49
Professional Services.	199
CLASSIFIED ADVERTISING	
F. J. Eberle, Business Mgr.	
EMPLOYMENT	
OPPORTUNITIES	200
EQUIPMENT	
(Used or Surplus New)	
For Sale	200-205
WANTED	
Equipment	201
ADVERTISERS INDEX	
American Air Compressor Corp.	202
Arro Equipment Company.	202
Brill Equipment Company.	201-204
Bristol Company	200
Chemstrand Corporation	200
Doyle & Roth Sales Corp.	200
Equipment Clearing House Inc.	204
Erman-Howell, Div., Luria Steel &	
Trading	202
Esso Research & Engineering Co.	202
First Machinery Corp.	203
Gelb & Sons, R.	205
Heat & Power Company.	203-204
Land, Inc. L. J.	204
Lawler Company	204
Linde Company	
A. Div. of Union Carbide Corp.	200
Loeb Equipment Supply Co.	202
Machinery & Equipment Co.	
(Calif.)	201-202-204
Machinery & Equipment Corp.	
(New Jersey)	202
Mansol Ceramics Company.	201
Near East College Association	
Inc.	200
Perry Equipment	
Corporation	201-204
Stanhope Inc., R. C.	202
Stein Equipment Company.	204
Sussman Inc., Louis.	202
Union Standard Equipment Co.	201



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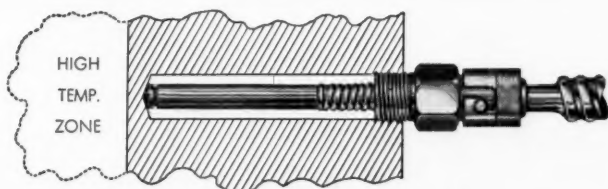


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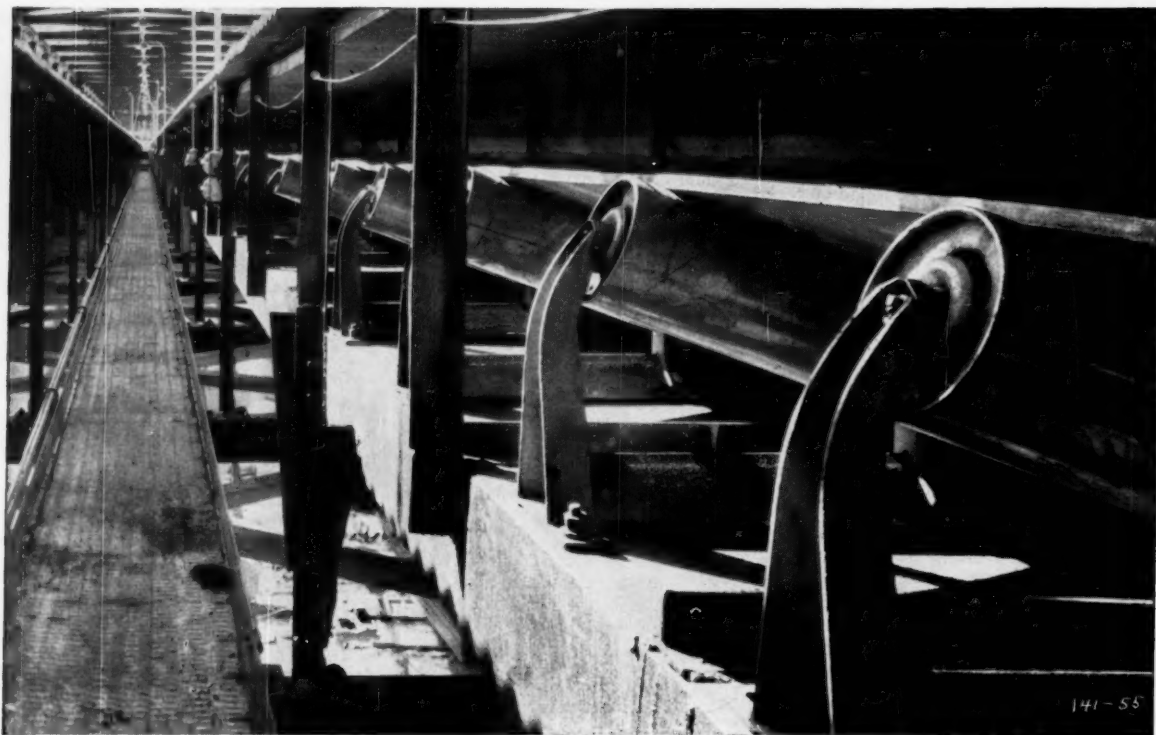
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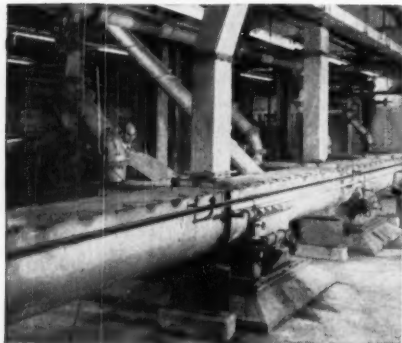
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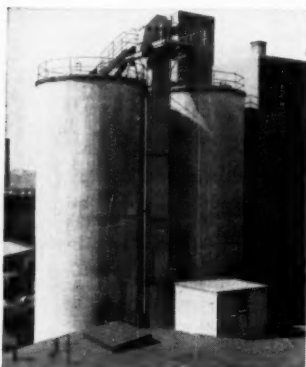
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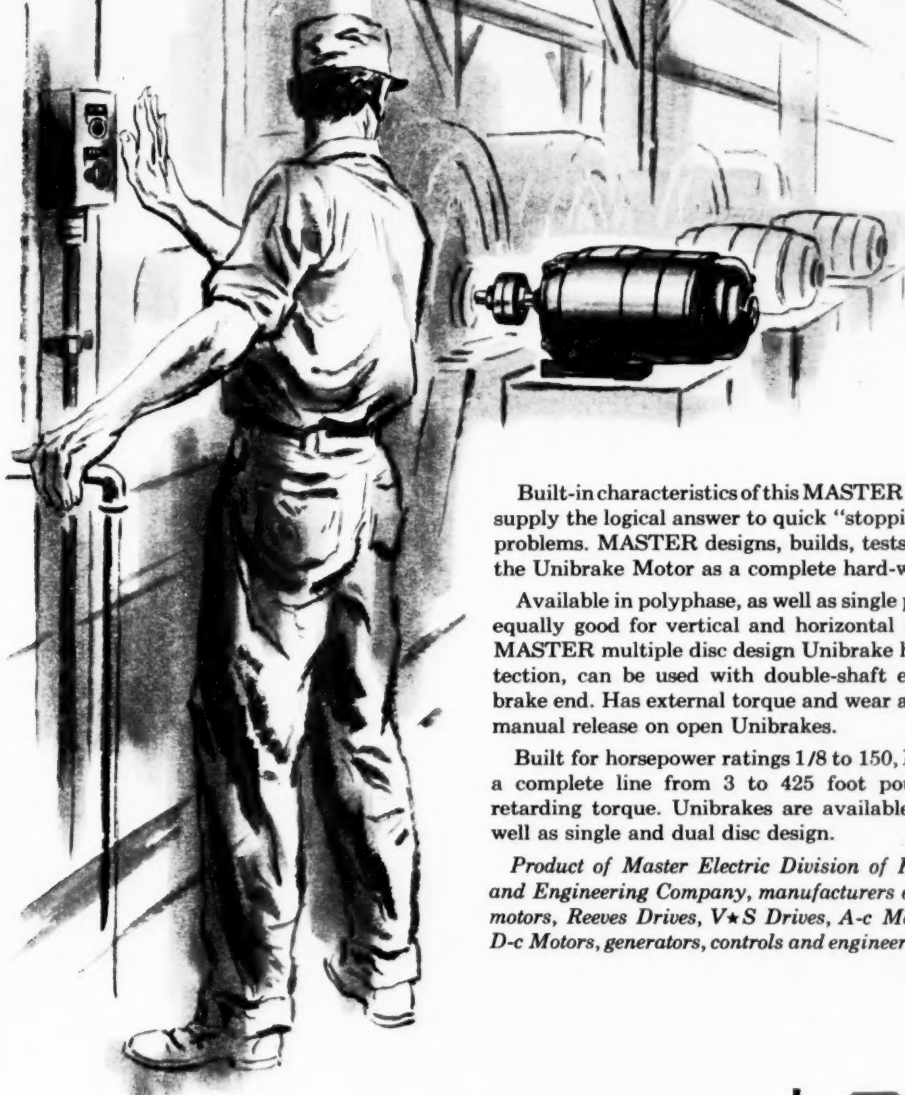
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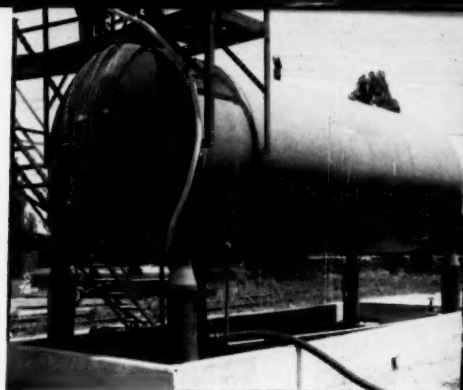
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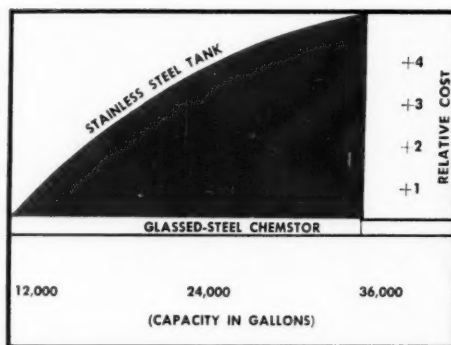
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